

**ARROWBROOK CENTRE
TRAFFIC IMPACT STUDY
FAIRFAX COUNTY, VIRGINIA**

Prepared for:
The Arrowbrook Centre

Prepared by:
Wells & Associates, LLC

May 14, 2003

(Revised June 27, 2003)

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FAIRFAX COUNTY, VIRGINIA

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INTRODUCTION

This report presents the results of a traffic impact assessment prepared in support of three zoning applications filed with Fairfax County, Virginia (see Appendix A - Statement of Justification). The properties that comprise the application(s), Tax Map 16-3 ((1)) 4, 4B, 4C, 5 and 39, total 53.84 acres. Parcels 4, 5, and 39 are zoned R-1 (Residential @ one dwelling unit per acre) and are largely undeveloped but do include single-family residences and accessory structures. Parcels 4B and 4C are also undeveloped and zoned I-4 (Medium Intensity Industrial).

The properties are located on the south side of the Dulles Toll Road (Route 267), north of Sunrise Valley Drive (Route 665), and west of Centreville Road (Route 657) in Land Unit A of the Dulles Suburban Center in Area III of Fairfax County. (See Figure 1) Land Unit A, according to the Plan, "encompasses the highest planned intensities in the Dulles Suburban Center."

As outlined in the statement of justification, the applicants propose to develop the properties with a mix of commercial and residential uses as reflected on Figure 2 and outlined below:

- 550,000 Gross Square Feet (GSF) of office uses
- 1,056 multi-family residential dwelling units
- 300 hotel rooms
- 176,372 GSF of retail uses

The primary purpose of this assessment is to evaluate the impact of this proposed new mixed-use development upon the surrounding street system. For purposes of this assessment, build out of the property referred hereinafter as "Arrowbrook Centre", is anticipated in the year 2010.

Tasks undertaken during the course of this study included the following:

1. A review of the plans proposed by the applicants for Arrowbrook Centre.

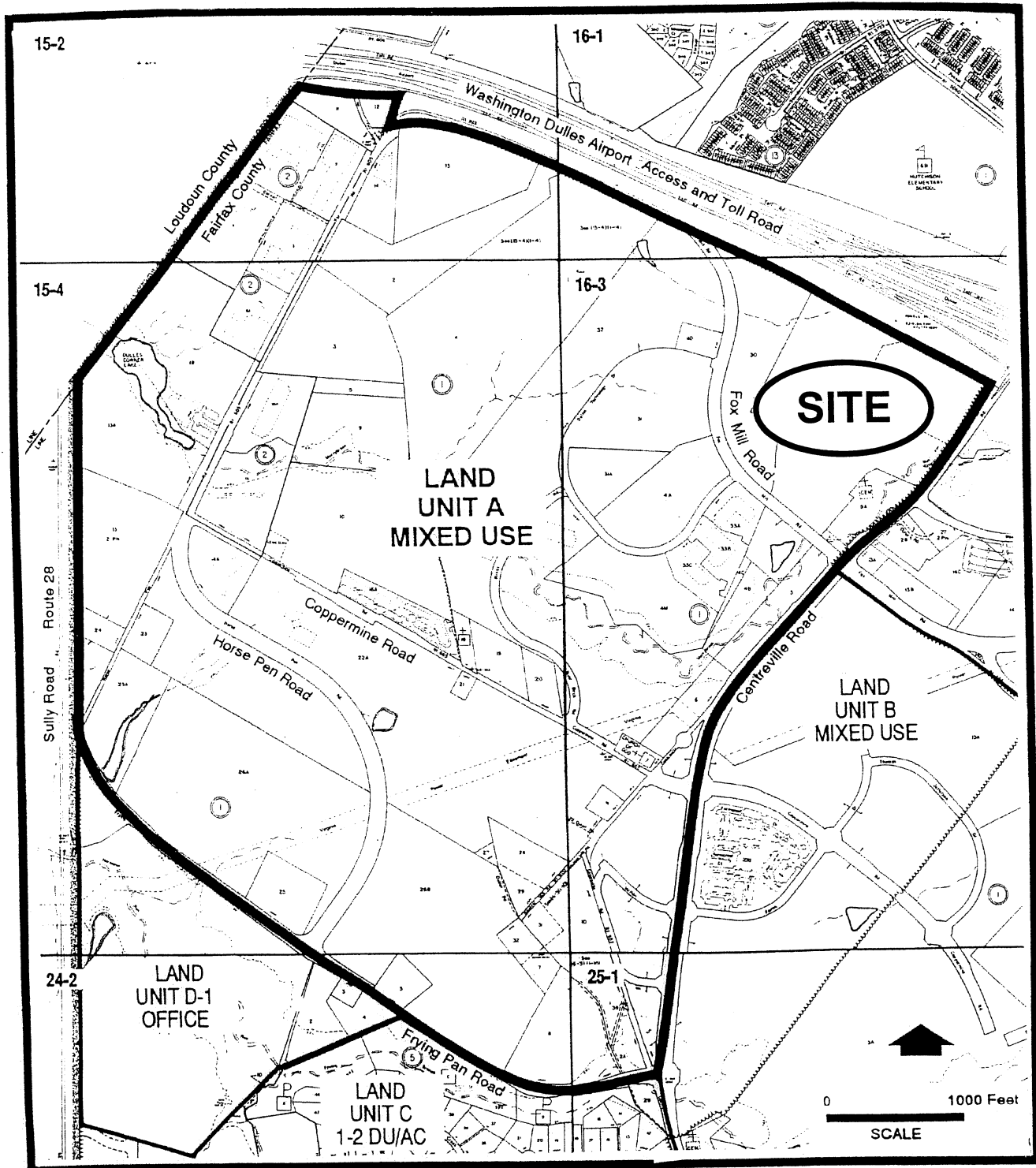
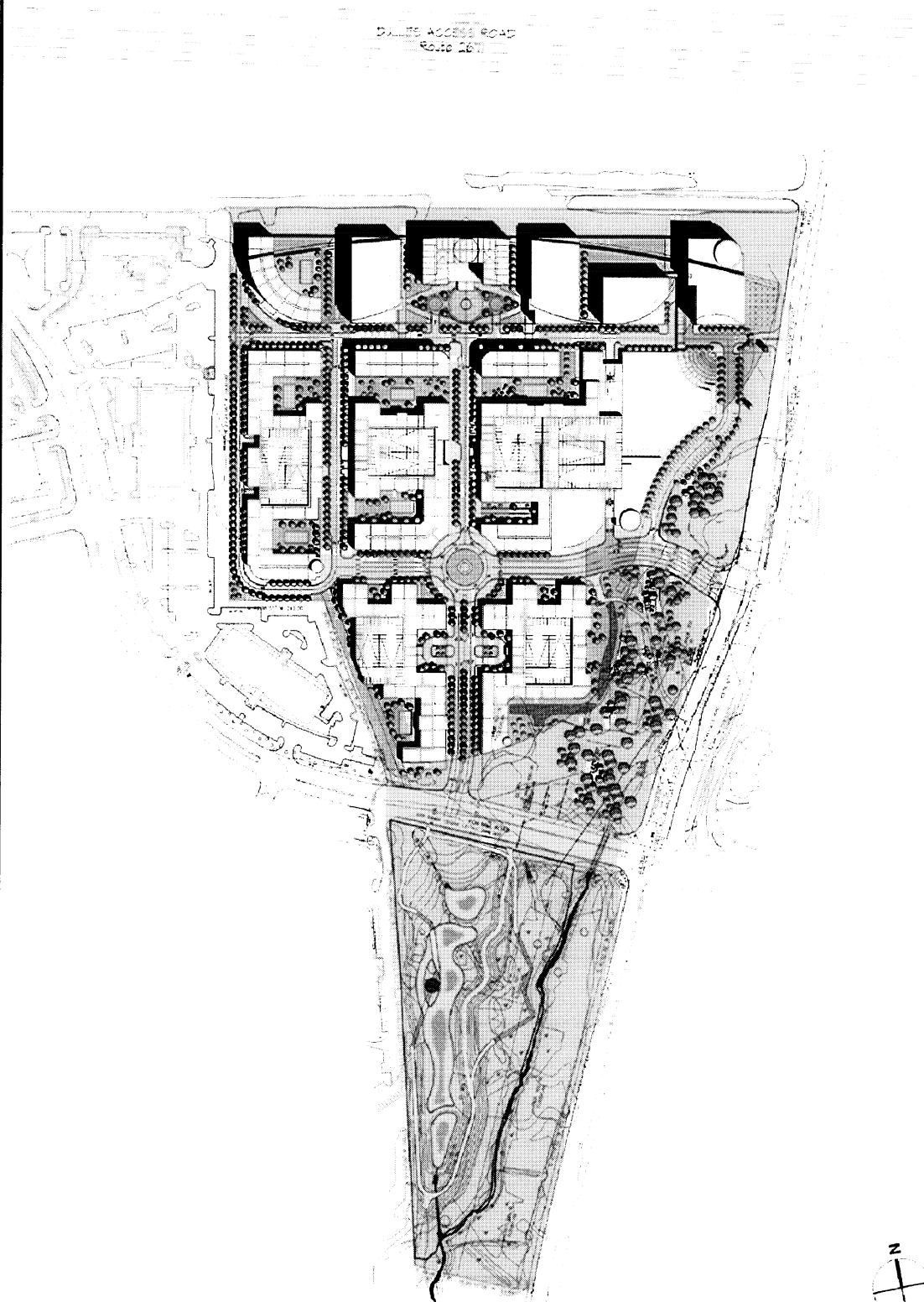


Figure 1
 Fairfax County Comprehensive Plan:
 Land Unit A.

North
 Schematic



3

ARROWBROOK CENTRE

APRIL 2003

DAVIS • CARTER • SCOTT

Figure 2
Site Plan Reduction

Arrowbrook Centre
Fairfax County, Virginia

WELLS & ASSOCIATES, LLC.
TRAFFIC, TRANSPORTATION, and PARKING CONSULTANTS

2. Meetings and on-going discussions with staff from the Fairfax County and Virginia Departments of Transportation.
3. A detailed field reconnaissance of existing roadway and intersection geometrics, traffic controls, and traffic signal timings/phasing.
4. Collection of AM and PM peak hour traffic counts at the following key study intersections:
 - a. Centreville Road/Dulles Toll Road Eastbound Ramps
 - b. Centreville Road/Woodland Park Road
 - c. Centreville Road/Sunrise Valley Drive
 - d. Sunrise Valley Drive/Dulles Technology Drive
5. Estimation of synergy among the proposed mix of uses.
6. Coordination with the Metropolitan Washington Council of Governments (COG) office in Washington, DC for information regarding growth in the Dulles Corridor over the next 20 years.
7. Estimation of the number of weekday AM and PM peak hour traffic forecasts with the development of the subject site as currently proposed.
8. Development of total future traffic forecasts for the projected build out year of 2010 with and without the proposed mixed-use development.
9. Determination of existing and future levels of service at key study intersections with and without the Arrowbrook Centre development.
10. Identification of transportation improvements needed to mitigate the impacts of future development.

Sources of data for this analysis include traffic counts conducted by Wells & Associates, LLC, the Institute of Transportation Engineers (ITE), the Highway Capacity Manual 2000 (HCM), the Washington Metropolitan Council of Governments (COG), the Traffic Analysis and Station Access Study - Technical Report (Dulles Corridor Rapid Transit Project), Walsh Colucci Emrich Lubeley & Terpak, the Virginia Department of Transportation (VDOT), Patton Harris Rust & Associates, Davis Carter Scott, and the Fairfax County Departments of Transportation (FCDOT) and Planning & Zoning.

The conclusions of this assessment are as follows:

- 1. Concentrating densities, pedestrian-friendly, mixed-use development in designated suburban activity centers and proximate to future rail stations, such as Arrowbrook Centre, is the best plan for responsible and smart growth in Fairfax County.***
- 2. According to the Comprehensive Plan, the estimated maximum amount of non-residential development that could occur in the Dulles Suburban Center, given "stable" development, proffered intensities, and by-right zoning is over 140 million gross square feet of floor area.***
- 3. Development within Land Unit A is projected to increase dramatically within the next 10 years. A total of 4.0 million square feet of non-residential development and over 2,300 residential units are either planned, and/or approved and anticipated to be built by the year 2010 based on COG absorption rates.***
- 4. This level of development within the Land Unit could generate an additional 7,601 AM peak hour trips, 7,322 PM peak hour trips and 59,683 daily trips upon completion based on typical, auto-oriented, suburban development practices.***

5. Road improvements proffered by neighboring developments within Land Unit A may increase capacity in the short and long-term at select locations. This additional capacity probably will not completely offset future increases in areawide traffic volumes. Analyses have shown that in the year 2010, without the development of Arrowbrook Centre, key study intersections would operate at capacity.
6. The development of Arrowbrook Centre, as proposed, would add 1,020 new AM peak hour trips, 1,248 new PM peak hour trips, and 19,281 daily trips to the surrounding street system upon completion. The level of development proposed is compatible with the Plan recommendations for the property.
7. The development of Arrowbrook Centre, based on the parameters assumed herein, will have an impact on the surrounding street system. Although intersection levels of service generally remain consistent with background levels increased vehicle delays would occur.

The implementation of mass transit in the Dulles corridor, combined with enhanced and aggressive TDM measures, would result in further mitigation of impacts. Locating residential and commercial uses, such as those proposed by the applicant within a half mile of the future Route 28/CIT transit station will increase mode splits and reduce the volume of single occupant vehicle trips beyond those referenced herein.

8. As congestion occurs and increases, a shift in driver patterns would occur whereby traffic demand is spread out over longer periods. By forcing a portion of the demand into the "shoulder hours", a more optimal use of existing and future capacity is realized.
9. In order to mitigate the impacts associated with the Arrowbrook Centre development, the following improvements are recommended:

- a. *Provision of dual left-turn lanes on northbound Centreville Road at the site entrance opposite Woodland Park Road*
- b. *Provision of an exclusive right-turn deceleration lane on southbound Centreville Road at the site's entrances*
- c. *Signal modifications to the Centreville Road/Woodland Park Road intersection*
- d. *Provision of exclusive right and left-turn deceleration lanes into the site entrance on Sunrise Valley Drive*
- e. *Provision of a traffic signal when warranted at the site's proposed entrance on Sunrise Valley Drive*
- f. *Provision of an integrated pedestrian network to connect with the future BRT and/or rail station platform*
- g. *Commitments to provide a transportation systems management program, the goal of which is to achieve a minimum 15% mode split*

BACKGROUND DATA

Comprehensive Plan Recommendations - Dulles Suburban Center

Overview. Arrowbrook Centre is located within Land Unit A of the Dulles Suburban Center. Land Unit A consists of a total of approximately 645 acres. Land Unit A is bounded on the north by the Dulles Toll Road (Route 267), on the east by Centreville Road (Route 657), on the west by Route 28, and on the south by Frying Pan Road (Route 608). Access to the land unit is provided primarily by Sunrise Valley Drive, Frying Pan Road and Coppermine Road.

The majority of Land Unit A is zoned I-4 (Medium Intensity Industrial), I-5 (General Industrial) or PDC (Planned Development Commercial) and developed with a variety of commercial and residential uses, including mid and high-rise office and hotel uses, multi-family residential uses and a number of single-family attached communities. The Merrybrook Run Stream Valley traverses the land unit, including Arrowbrook Centre, and represents a constraint upon development as well as a natural open space amenity.

According to the Plan, in order to achieve the concept for future development within the Dulles Suburban Center, a number of significant planning issues must be addressed. The most significant constraint on future development within the Center is the capacity of the planned transportation system.

Area-Wide Transportation Recommendations. A number of area-wide transportation objectives and improvements are recommended within the Plan text for the Dulles Suburban Center. A complete copy of the Plan text is included as Appendix B.

Specific roadway improvements for the area are depicted on Figure 3. As shown on Figure 3, the Plan recommends that Sunrise Valley Drive along the site's frontage be widened to a four-lane, median-divided roadway, Centreville Road be improved to provide for six lanes with interchange improvements constructed at the Dulles Toll Road. Details of each of the

Fairfax County Dulles Suburban Center Transportation Recommendations

TRANSPORTATION RECOMMENDATIONS LEGEND

● **ROAD AND HIGHWAY FACILITIES**

ARTERIAL	COLLECTOR	LOCAL
WIDEN OR IMPROVE EXISTING ROADWAY		
CONSTRUCT ROADWAY ON NEW LOCATION		
TOTAL NUMBER OF LANES, INCLUDING HOV LANES (COLLECTOR/LOCAL CROSS SECTIONS TO BE FINALIZED DURING PROCESS OF REVIEWING PLANS FOR PROPOSED DEVELOPMENT)		
2	4	6 8

○ CONSTRUCT GRADE-SEPARATED INTERCHANGE
OR INTERCHANGE IMPROVEMENTS

→ PROVIDE PRIMARY SITE/AREA ACCESS IN LOCATION(S)
SHOWN. SEE SITE ACCESS DISCUSSION IN AREA PLAN
OVERVIEW TEXT.

NOTE: IMPROVEMENTS TO ARTERIAL FACILITIES SUBJECT TO COMPLETION OF CORRIDOR
STUDIES. SEE DISCUSSION IN AREA PLAN OVERVIEW TEXT. FINAL ALIGNMENTS
SUBJECT TO COMPLETION OF APPROPRIATE ENGINEERING STUDIES.

HOV LANES TO BE CONSIDERED IN PROJECT DEVELOPMENT. HOV LANES TO BE
PROVIDED IF WARRANTED BASED ON DEMAND FORECASTS AND CORRIDOR STUDY

T	TRANSIT TRANSFER CENTER (no parking)
R	RAIL STATION
P	COMMUTER PARKING LOT

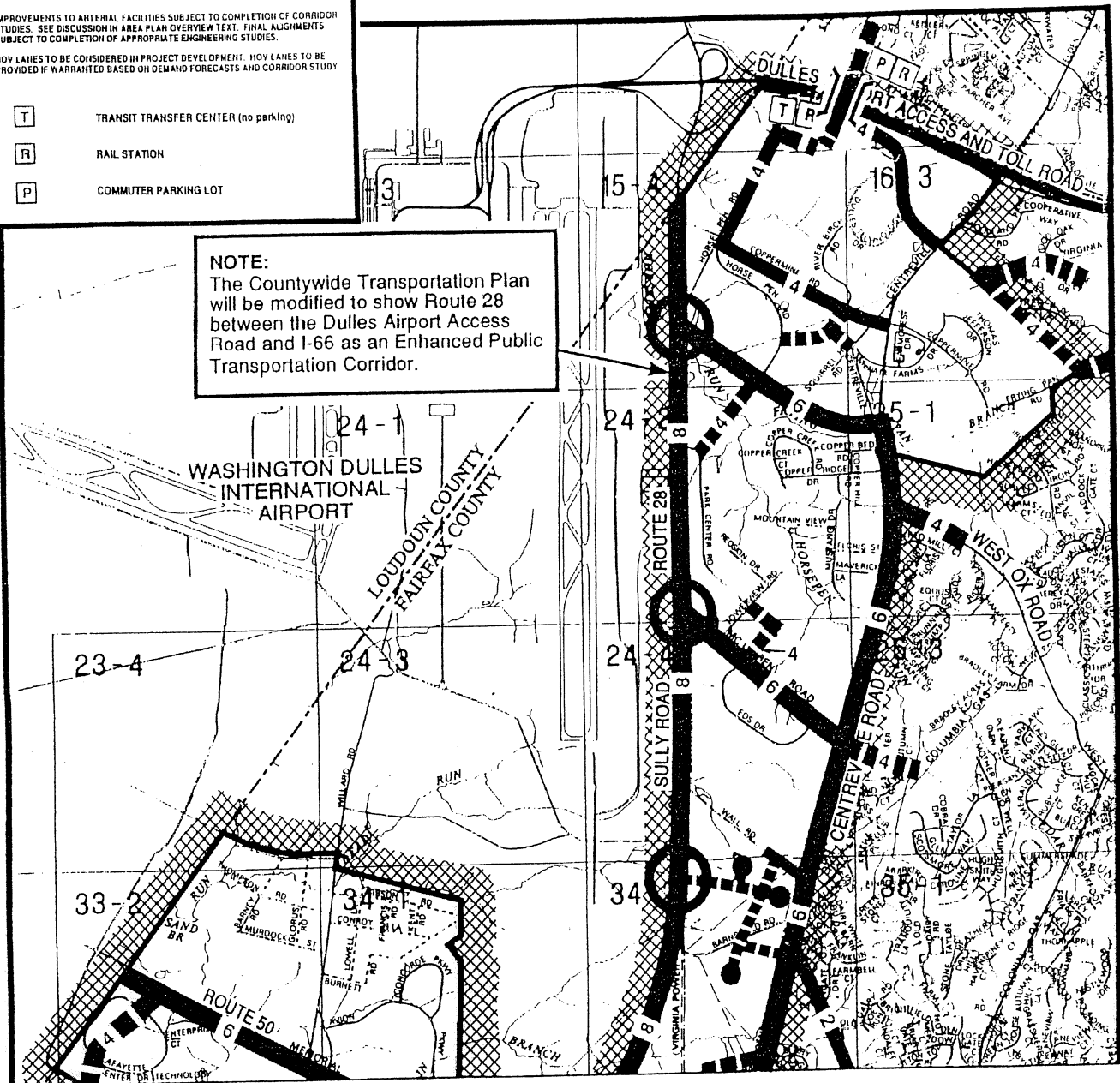


Figure 3
Fairfax County Comprehensive Plan
Transportation Map Plan



above recommendations will be discussed in a subsequent section of this report.

Land Unit A Plan Recommendations. The current Plan text for the land unit recommends "a complimentary mix of land uses including office, hotel, and support retail uses at .50-1.0 FAR. Optional residential uses should be considered as part of any mixed-use development proposal." According to the Plan, a cohesive and integrated mix of residential and non-residential uses should "provide convenience to those who live and work in the area." Development within the land unit should also provide for the future incorporation of transit related facilities and pedestrian access to transit.

The Plan also provides for transit improvements for the Dulles Airport Access Road (DAAR) corridor. A Major Investment Study (MIS) completed in 1997 and updated in 1999 recommended that a transit station be located adjacent to Land Unit A in the vicinity of the CIT. As an incentive to smart growth, the Comprehensive Plan was amended on May 21, 2001 to permit optional increased densities along the DAAR corridor with the advent of Bus Rapid Transit (BRT) or Metro-like rail.

With the advent of a full funding agreement for rail or BRT, increased densities up to 1.5 FAR for mixed-use projects within $\frac{1}{4}$ mile of the station platform and 1.25 FAR within $\frac{1}{2}$ mile were deemed appropriate. In order to achieve these levels a number of development conditions had to be met. After careful consideration of the Plan conditions and constraints limiting development on the parcel, the applicants decided to develop the property in accordance with the Plan's baseline recommendations of 0.5 to 1.0 FAR.

Existing Road Network

Overview. Access to the land unit would be provided by full movement entrances on Centreville Road and Sunrise Valley Drive. Traffic signals are located on Centreville Road at the eastbound Toll Road ramps, Woodland Park Road, and Sunrise Valley Drive. A right-in/right-out entrance is also proposed on Centreville Road

just south of the eastbound Toll Road ramps. Figure 4 depicts existing lane use and traffic controls in the site vicinity. A brief description of each roadway is provided below:

Dulles Toll Road (Route 267). The Dulles Toll Road is an eight-lane, median-divided, freeway that serves as one of the primary commuter routes between Loudoun County to the west and the Capital Beltway (I-495) to the east. High Occupancy Vehicle (HOV) lanes are in place between Loudoun County and the Capital Beltway. The posted speed is 55 miles per hour (mph).

The segment of the Toll Road in the vicinity of the site presently carries approximately 89,000 vehicles per day (vpd). Access is limited to grade-separated interchanges. The Toll Road access ramps to/from Centreville Road currently operate under signal control.

Sully Road (Route 28). Sully Road is a six-lane, median-divided, freeway, extending from Prince William County in the south to Loudoun County in the north. Access to Sully Road is restricted to existing and/or planned interchange locations only. The segment of Route 28 between the Dulles Toll Road and Route 50 carries approximately 78,000 vpd. The posted speed is 55 mph in the vicinity of Frying Pan Road.

Centreville Road (Route 657). Centreville Road is currently constructed as a five-lane, undivided, minor arterial roadway south from the Dulles Toll Road to Sunrise Valley Drive. This segment provides two southbound and three northbound through lanes and carries approximately 47,000 vpd. South of Sunrise Valley Drive, Centreville Road is constructed as a six-lane divided roadway, providing three thru lanes in each direction. Signalized intersections, proximate to the site, are currently located at the Dulles Toll Road eastbound ramps, Woodland Park Road, and Sunrise Valley Drive.

Centreville Road is posted with differing speed limits north and south of Sunrise Valley Drive. North of Sunrise Valley Drive, the posted speed is 35 mph; while to the south it is 40 mph.

Sunrise Valley Drive (Route 5320). Sunrise Valley Drive is, for much of its length, constructed as a four-lane, median divided collector roadway. The segment of Sunrise Valley Drive west of

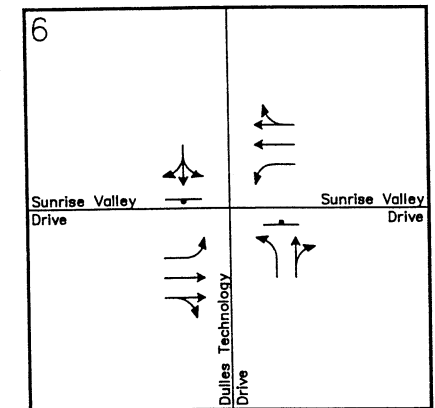
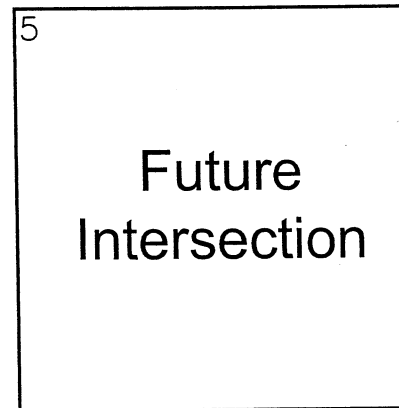
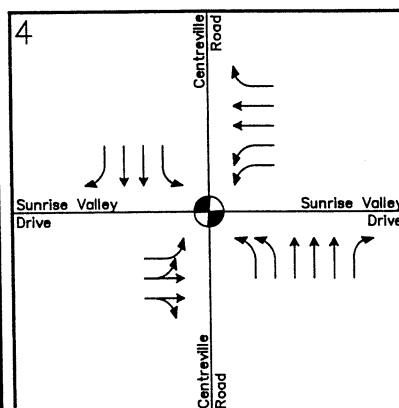
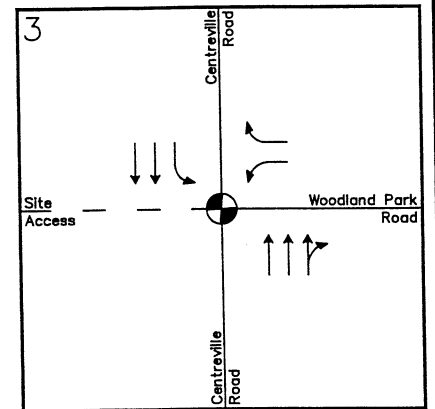
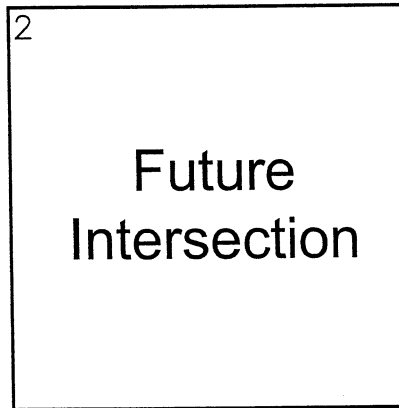
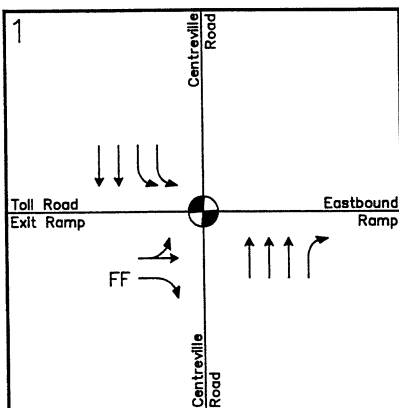
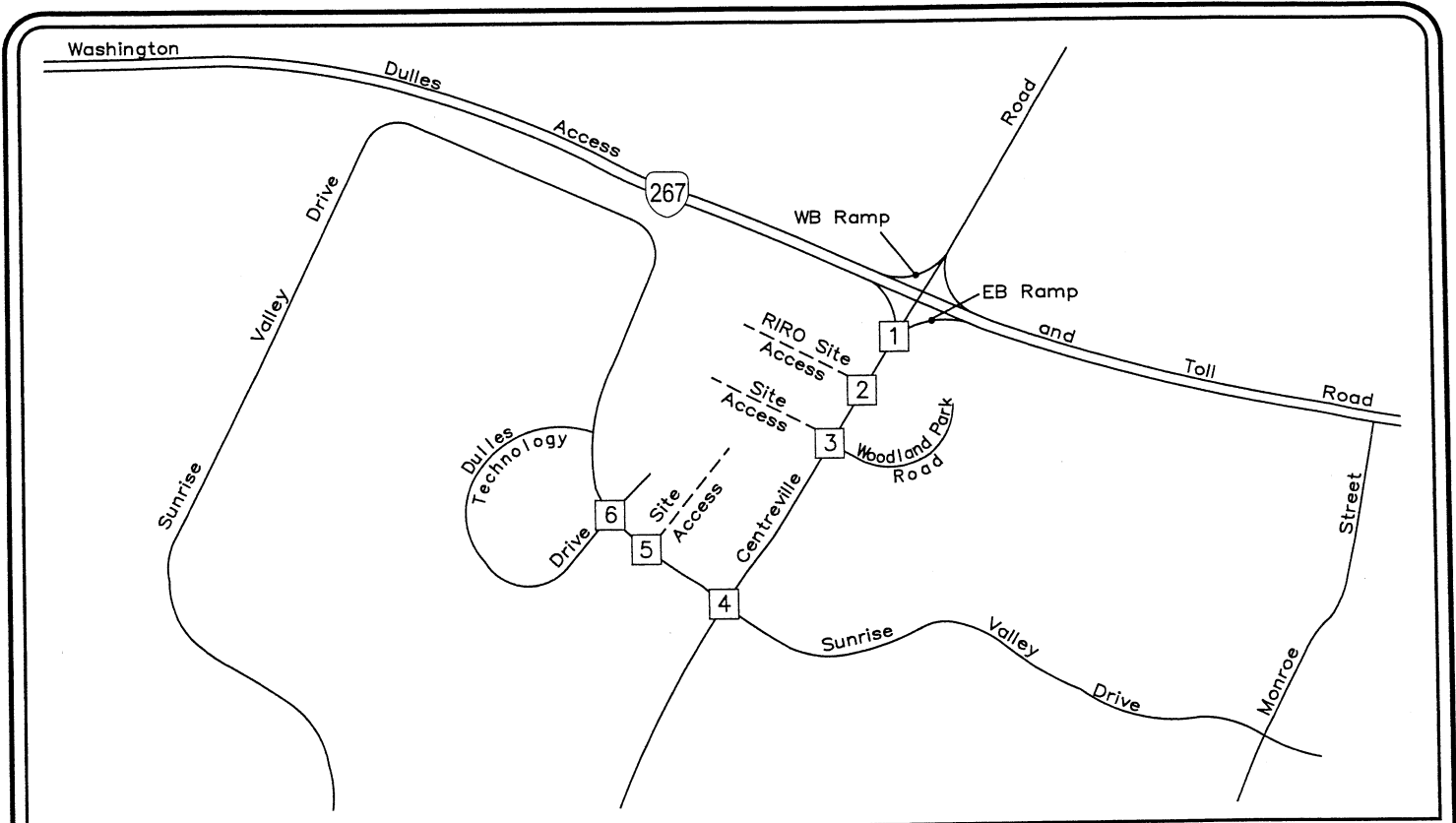


Figure 4
Existing Lane Use and Traffic Controls

← Represents One Travel Lane
 ⊗ Signalized Intersection
 — Stop Sign
 FF Represents Free Flow Lane
 North Schematic

C:\Projects\1995 Arrowbrook Centre\Graphics\1995_Lanes-HWord

the subject site converges back to a two-lane roadway. The intersection of Sunrise Valley Drive and Centreville Road currently operates under signal control. In vicinity of the subject site, the posted speed limit is 35 mph. In 2001, the roadway carried approximately 11,000 vpd east of Centreville Road and 8,300 vpd west of Centreville Road.

Future Planned Roadway Improvements

The transportation element of the Fairfax County Comprehensive Plan is the blueprint for transportation improvements in the County. Both the transportation plan map and the plan text for Area III, Dulles Suburban Center, recommend a number of improvements in the vicinity of the Arrowbrook Centre site. A copy of the relevant plan map, as well as the plan text are provided on Figure 3 and Appendix B, respectively.

Dulles Toll Road (Route 267). The Toll Road was recommended to be widened to eight (8) lanes with provision made for high occupancy vehicle (HOV) lanes, as well as additional improvements to the Centreville Road interchange. The construction of these HOV lanes and additional widening were completed in the spring/summer of 1999.

Sully Road (Route 28). Sully Road is recommended to be improved to an eight-lane facility from I-66 north to Loudoun County. Grade-separated interchanges are to be provided at all existing full movement intersections within Fairfax County.

As part of the Public-Private Transportation Act (PPTA), a private consortium of Clark Construction and Shirley Contracting was selected to design and construct the Route 28 Corridor Improvements, between I-66 in Fairfax County and Route 7 in Loudoun County. The plan includes the widening of Route 28 from six (6) to eight (8) lanes and interchanges at Westfields Boulevard, Willard Road, Barnsfield Road, and Frying Pan Road.

The Frying Pan Road interchange, which is in the vicinity of the Arrowbrook Centre site, would be constructed in the later phases of the project. The estimated completion for the interchange is no earlier than December 2005. The addition of this new

interchange will allow easy access for Arrowbrook Centre's residents and tenants to and from points south along the Route 28 corridor.

Centreville Road (Route 657). As seen on the Transportation Plan map, Centreville Road has no recommended future improvements/widening along the segment between Sunrise Valley Drive and the Dulles Toll Road. However, the Plan text for the Upper Potomac planning sector for Area III recommends that this section of Centreville Road be widened to a six-lane roadway.

Sunrise Valley Drive (Route 5320). Sunrise Valley Drive is recommended to be widened to provide a continuous four-lane, median-divided, roadway from Frying Pan Road to Centreville Road. In addition, a new north-south crossing of the Dulles Toll Road, connecting Horse Pen Road on the south side with Rock Hill Road on the north is planned.

Proffered Roadway Improvements

During the last decade, a number of significant and expansive developments, both commercial and residential, have been approved by the Fairfax County Board of Supervisors in the areas adjacent to and in the vicinity of the proposed Arrowbrook Centre site. In conjunction with the approval of these projects, several major transportation improvements were proffered that would have an impact on traffic operations in the immediate vicinity of Arrowbrook Centre. These proffered improvements are depicted in red on Figure 5 and described below.

Dulles Station. The owners of Dulles Station have proffered the following transportation improvements:

1. Construct the southbound half-section of Centreville Road as a six-lane, divided roadway between the Dulles Toll Road (Route 267) and Sunrise Valley Drive (Route 5320). Proffer III.3.
2. Construct a southbound right turn lane on Centreville Road at Sunrise Valley Drive. Proffer III.3.

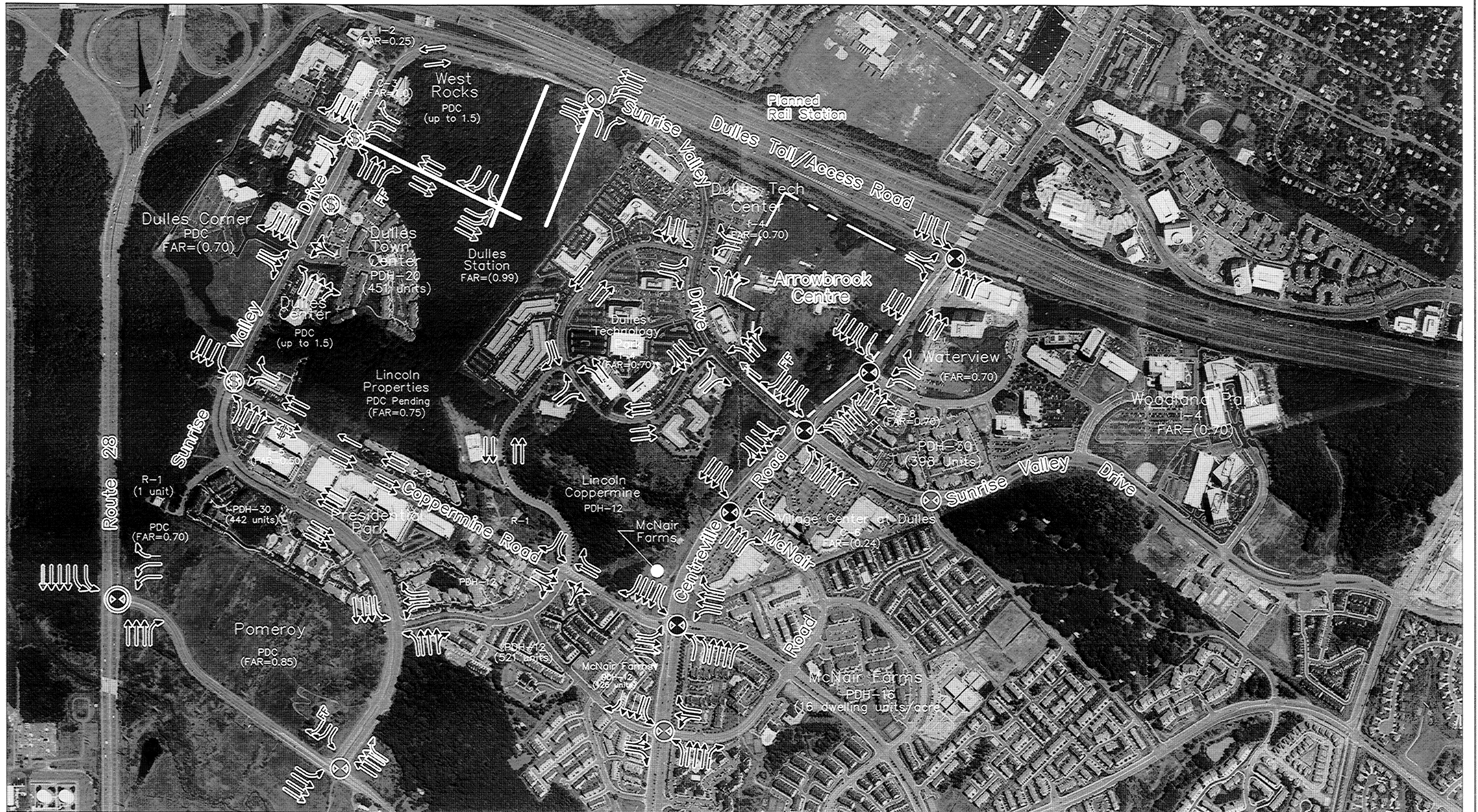


Figure 5 (Revised June 27, 2003)

Proffered Roadway Improvements

LEGEND	
Black	Existing Roadway Network
Red	Proffered Improvements By Others
Green	Planned Roadway Improvements
→	One Traffic Lane
⊕	Contribution to Lane
⊗	Traffic Signal
⊙	Contribution to Signal

NOT TO SCALE	
DATE:	22MAY03
DRAWN BY:	H.Ward
CHECKED BY:	RLA
Arrowbrook Property	
PROJECT NO:	1895

WELLS & ASSOCIATES, LLC.	
TRANSPORTATION, TRAFFIC, AND PARKING CONSULTANTS	
1420 Spring Hill Road, Suite 600, McLean, Virginia 22102	Phone: 703/917-6620 Facsimile: 703/917-0759
2661 Riva Road, Suite 300, Annapolis, Maryland 21401	Phone: 410/266-5723 Facsimile: 410/266-9189
420 Virginia Avenue, Towson, Maryland 21206	Phone: 410/825-2527 Facsimile: 410/825-2517

3. Construct an eastbound left turn lane from Sunrise Valley Drive onto Centreville Road, and an additional widening on westbound Sunrise Valley Drive to facilitate a southbound free-flow right turn from Centreville Road onto Sunrise Valley Drive. Proffer III.4.
4. Construct a southbound free-flow right turn lane on Sunrise Valley Drive onto Frying Pan Road. Proffer III.5.
5. Construct a single westbound lane on Frying Pan Road, between Sunrise Valley Drive and Route 28. Proffer III.5.
6. Contribute \$200,000 toward construction of a single eastbound lane on Frying Pan Road, between Route 28 and Sunrise Valley Drive. Proffer III.6.
7. Construct a four-lane, divided, internal roadway, between Sunrise Valley Drive and Fox Mill Road. Proffer III.7.
8. Install a new traffic signal on the internal roadway. Proffer III.8.
9. Dedicate right-of-way, and grant construction easements, for the Rock Hill Road extension over the Dulles Toll Road. (The owners are not responsible for construction of the flyover, however). Proffer III.9.
10. Construct through and turn lanes at the northern and western site entrances on Sunrise Valley Drive. Proffer III.10.
11. Install a new traffic signal at the northern site entrance on Sunrise Valley Drive. Proffer III.10.
12. Dedicate right-of-way along the site frontage for the ultimate improvement of Sunrise Valley Drive as six-lane, divided roadways. Proffer III.10.

13. Contribute \$50,000 towards a new traffic signal at the western site entrances on Sunrise Valley Drive. Proffer III.11.
14. Work with the Fairfax County Department of Transportation (DOT) to implement a Transportation Systems Management (TSM) program designed to encourage the use of public transportation, ride sharing, and staggered work hours. Proffer III.14.
15. Contribute \$0.10 per gross square foot of non-residential buildings to a fund established for the development of ancillary facilities (such as on-site pedestrian and vehicular facilities) to a proposed new commuter road station. Proffer III.15.
16. Dedicate three (3) acres for a transit facility parking lot. Proffer III.16.
17. Construct two (2) bus stops and shelters. Proffer III.17.
18. Participate as a full member of the Dulles Area Transit Association. Proffer III.18.

Woodland Park. The following improvements have been committed to by the developers/owners of Woodland Park:

1. Dedication of right-of-way along the property's Centreville Road frontage measuring 13 feet from the existing right-of-way as reflected on the proffered plan for a future right-turn lane from northbound Centreville Road onto the Dulles Toll Road eastbound ramp. Proffer 5a. and b.
2. Provision of a traffic signal at the intersection of Woodland Park Road and Centreville Road. Proffer 6.
3. Lengthening of the existing left-turn lane on Centreville Road at the site's Woodland Park Road intersection and provision of an additional left turn lane at the achievement of specific development levels. Proffer 7.

4. Implementation of transportation management strategies. Proffer 9.

Three Party Agreement. This agreement was entered into among three separate property owners including the developers of Dulles Corner. The main purposes of this agreement was to provide for an integrated approach to the design and construction of Sunrise Valley Drive from Frying Pan Road north; widen and improve Frying Pan Road, and construct an at-grade intersection on Frying Pan Road at Route 28.

It appears that all of the road improvements outlined in the agreement have been completed, with the exception of signalization of the Sunrise Valley Drive/Frying Pan Road intersection.

Dulles Corner. In addition to the three party agreement, the developers of Dulles Corner committed to the following:

1. A pro-rata contribution to the design and installation of a signal at Sunrise Valley Drive and Enterprise Drive, not to exceed \$50,000. Proffer 27.
2. Contributions per square foot to the improvement of the surrounding roadway and pedestrian connections if a rail station is located within $\frac{1}{4}$ mile of the property. Proffer 28.
3. Continued membership in the Dulles Area Transportation Association.

The improvements listed above are to be provided coincident with certain development thresholds. Certain improvements mentioned above have been implemented since the date of the developments' proffers taking place. Therefore, these improvements are included in our existing analyses. For purposes of this analysis, the completion of many of the improvements directly impacting the development of Arrowbrook Centre was assumed. Should these developments not reach proffered thresholds, the capacity associated with them would not be available. Figure 6 reflects the future lane use and traffic controls assumed for purposes of this analysis.

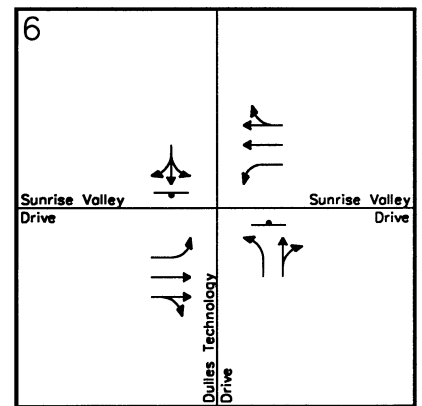
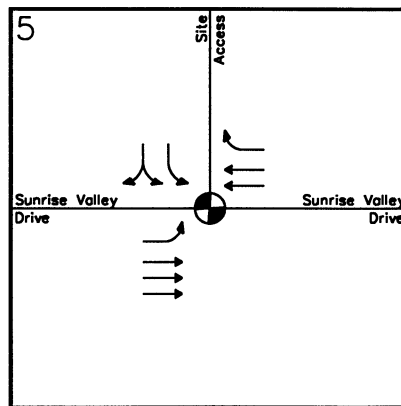
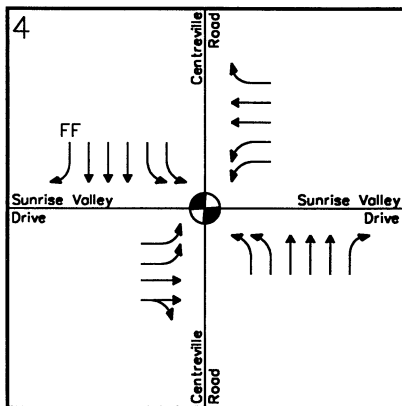
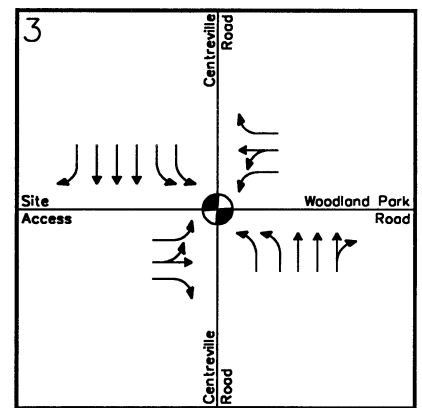
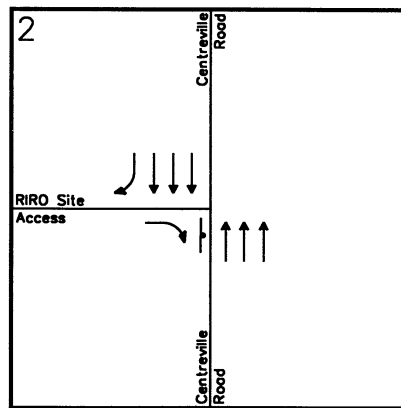
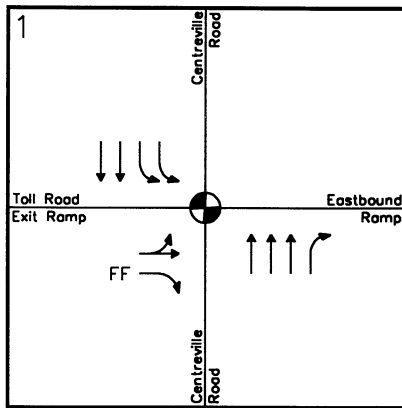
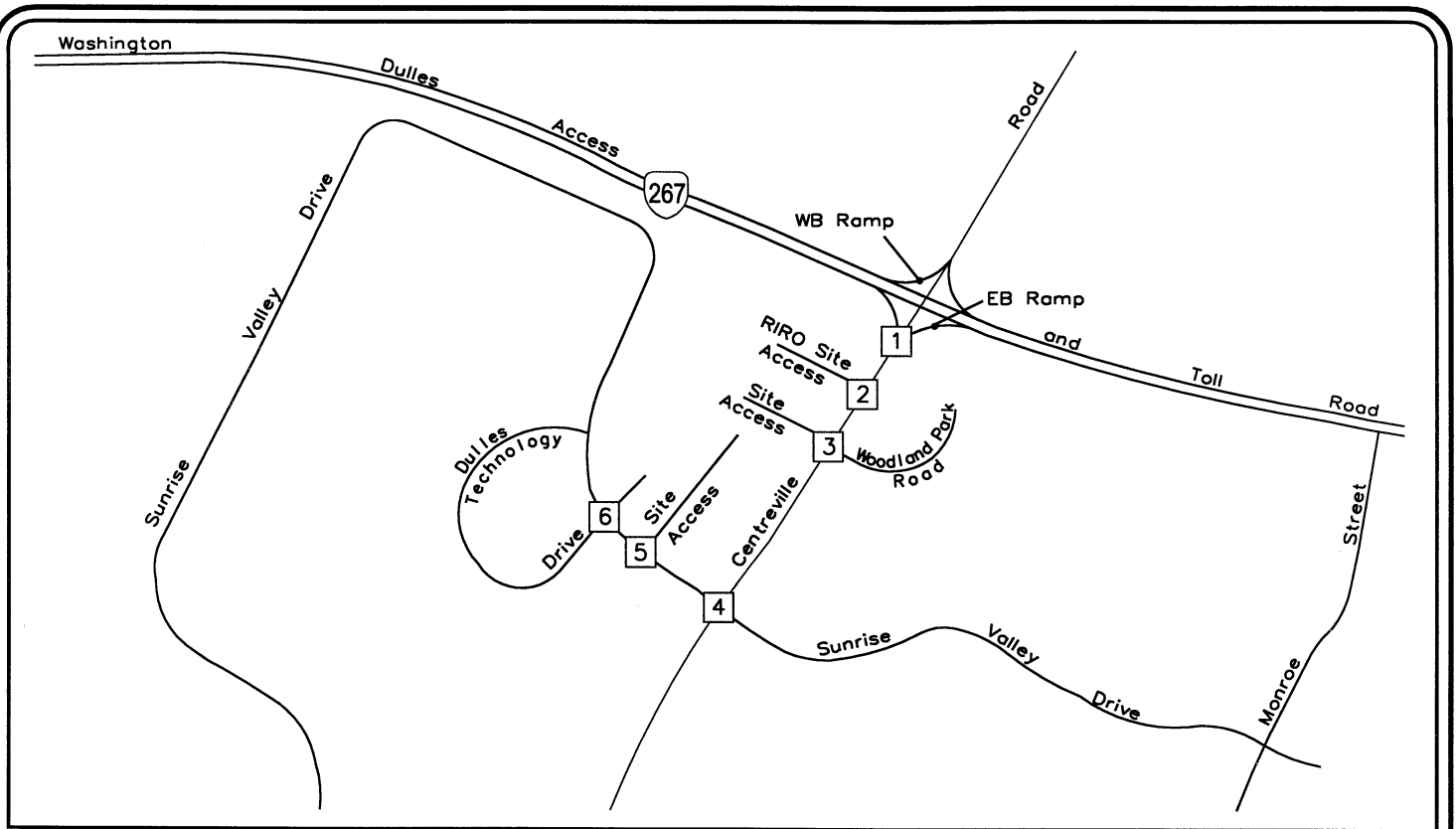


Figure 6 (Revised June 27, 2003)
Future Lane Use and Traffic Controls

← Represents One Travel Lane
 ⬤ Signalized Intersection
 — Stop Sign
 North Schematic

Existing Transit Service

Fairfax Connector service is currently available to serve the proposed site development with bus stops located on Sunrise Valley Drive and Centreville Road. Connector routes 927 and 929 provide peak hour service from the area to/from the Herndon-Monroe Park and Ride.

Existing Traffic Conditions

Peak hour traffic counts were conducted between the hours of 6:00 and 9:00 AM and 4:00 and 7:00 PM, at the following intersections on the following dates:

1. Centreville Road/Dulles Toll Road Eastbound Ramps (June 11, 2002)
2. Centreville Road/Woodland Park Road (June 11, 2002)
3. Centreville Road/Sunrise Valley Drive (May 21, 2002)
4. Sunrise Valley Drive/Dulles Technology Drive (November 12, 2002)

The resulting AM and PM peak hour traffic counts, are included in Appendix C, and summarized on Figure 7. Due to the variance in daily counts and peak hours, the raw counts reflected on Figure 7 were balanced and the adjusted baseline counts are summarized on Figure 8.

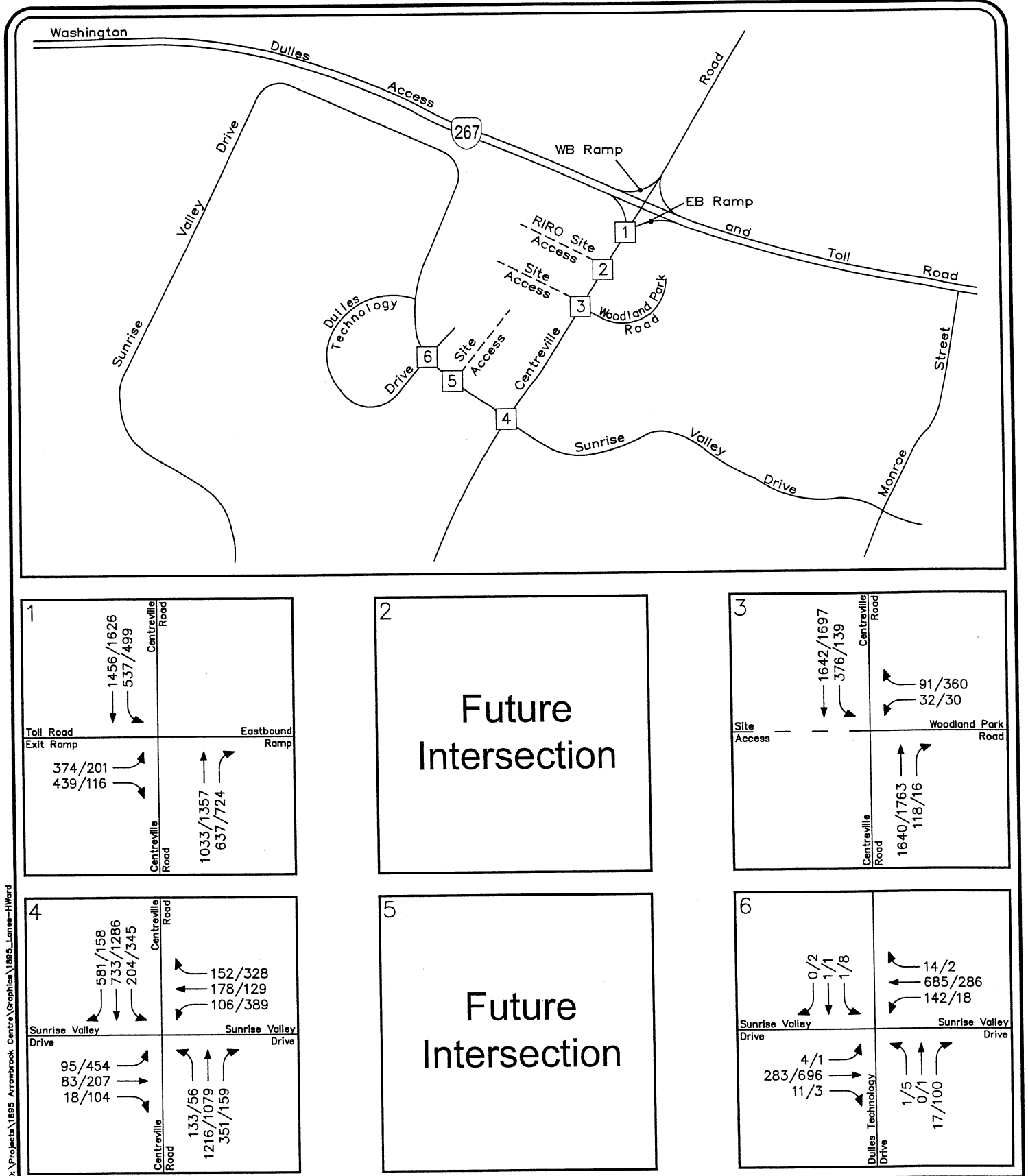


Figure 7
Existing Traffic Volumes

AM PEAK HOUR
PM PEAK HOUR
000/000

North
Schematic

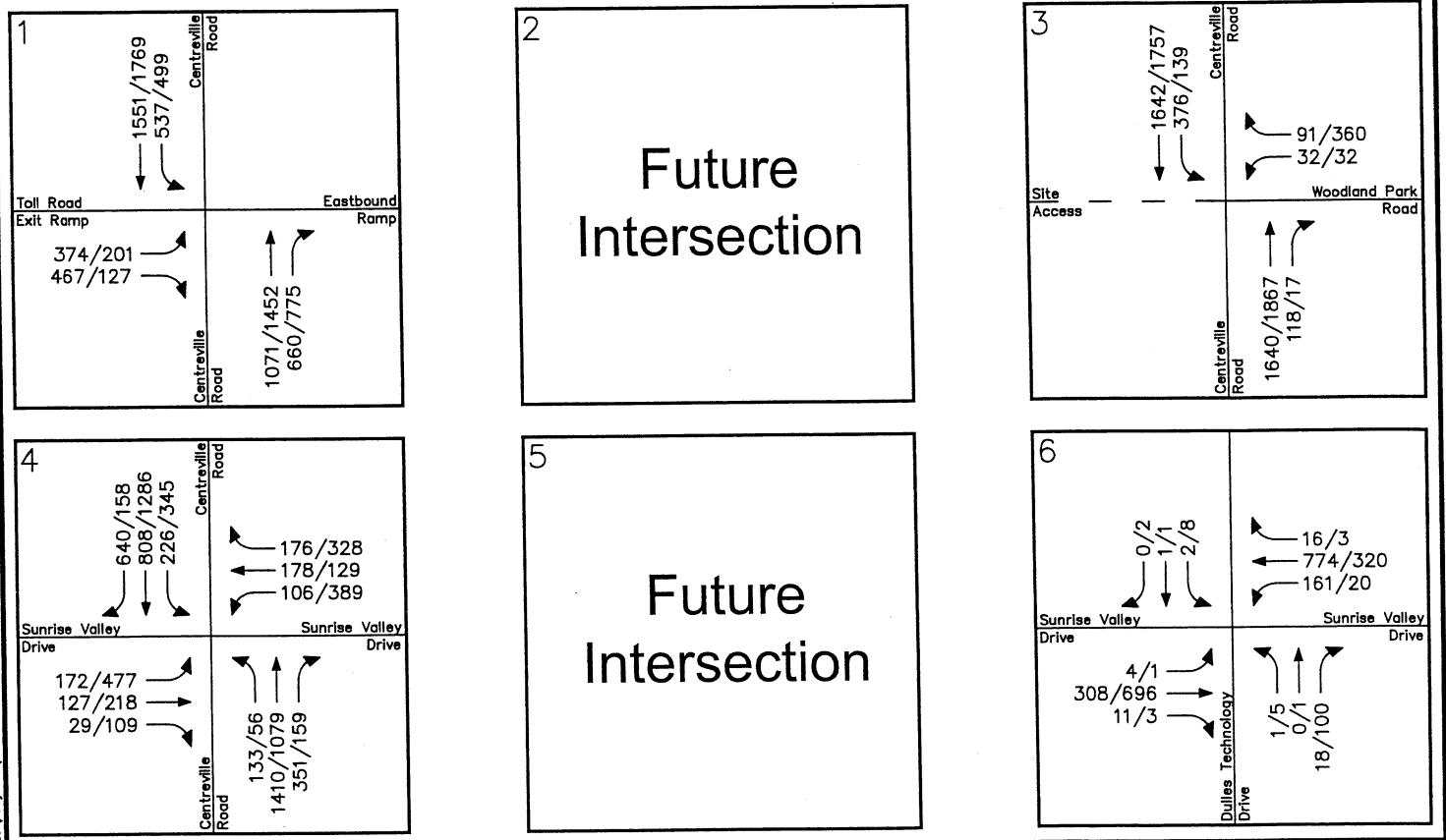
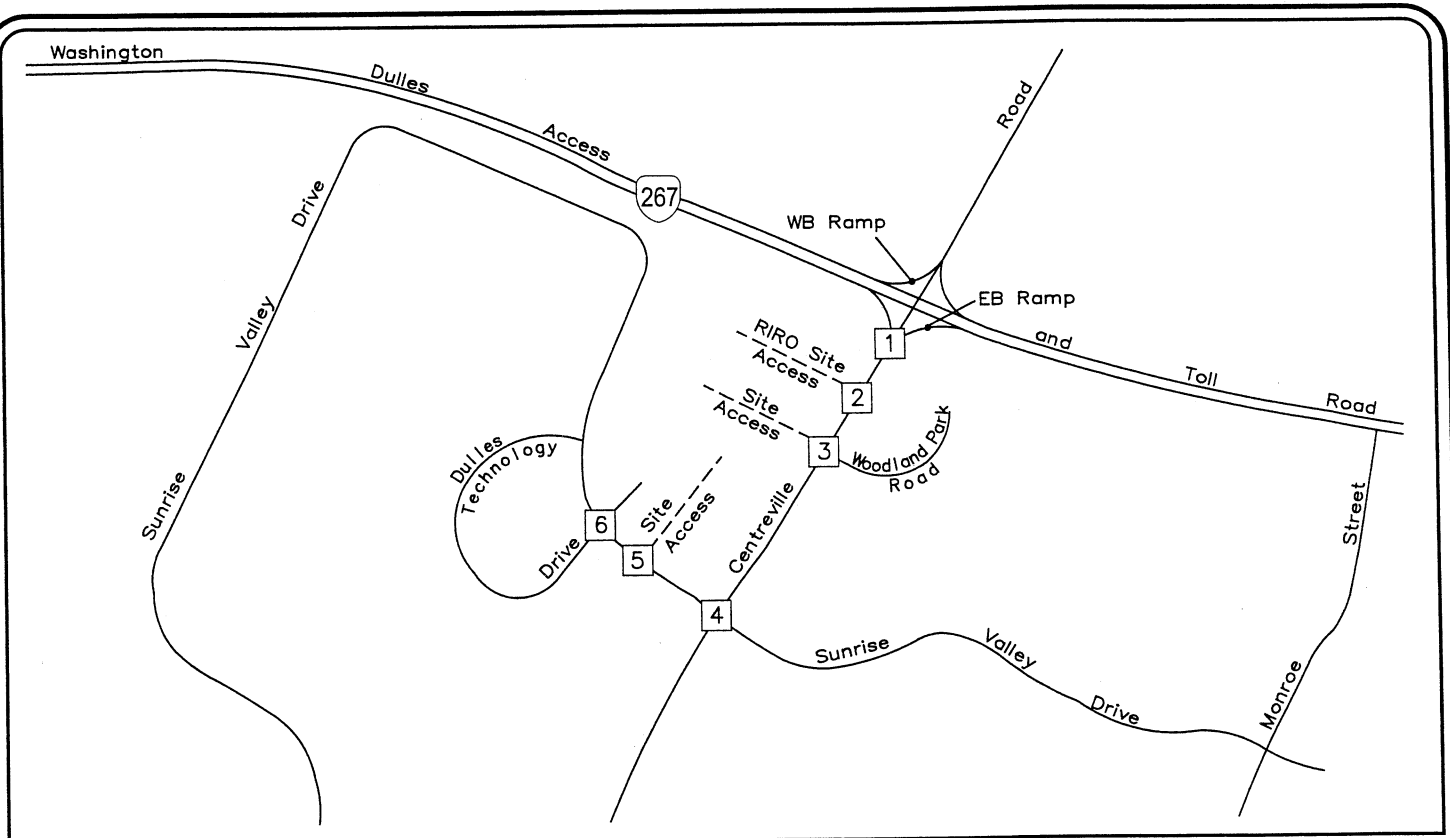


Figure 8
Existing Balanced Traffic Volumes

AM PEAK HOUR
PM PEAK HOUR
000/000

North
Schematic

ANALYSIS

Overview

In order to provide a complete assessment of the impacts associated with the build out of Arrowbrook Centre, Highway Capacity analysis techniques were used in assessing existing and future traffic conditions. A study scope was discussed, mutually agreed to in concept, and submitted to the Fairfax County and Virginia Departments of Transportation staff. A copy of the memorandum sent to Fairfax County staff that outlines the study scope, dated February 6, 2003, is included as Appendix D.

Existing Intersection Levels of Service

Existing peak hour levels of service (LOS) at the study intersections were calculated based on: (1) the baseline traffic volumes reflected on Figure 8; (2) the existing lane use and traffic controls depicted on Figure 4; (3) VDOT signal timings/phasing (See Appendix E); and (4) the Highway Capacity Manual 2000 (HCM) methodologies for unsignalized and signalized intersections (HCS software version 4.1c). The results of these analyses are presented in Appendix F and summarized in Table 1. A description of levels of service is provided in Appendix G.

Based on the aforementioned analyses, and as shown on Table 1, the signalized intersection of Centreville Road and Sunrise Valley Drive currently operates at an overall LOS "D" during the AM peak hour and "E" during the PM peak hour. The signalized intersections to the north on Centreville Road (Woodland Park Road and the Eastbound Dulles Toll Road Ramp) operate at an overall LOS "D" during the AM peak hour and "C" during the PM peak hour. Similarly, critical movements at the intersection of Sunrise Valley Drive and Dulles Technology Drive currently operate at acceptable levels of service under STOP controls during peak periods.

Table 1
Arrowbrook Centre
Level of Service Summary (1) (2)

Intersection	Traffic Control	Critical Movement	Existing 2002		Background 2010		Total Future 2010	
			AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1 Centreville Road/ Eastbound Dulles Toll Access Road Ramp	Signal	EB	E (73.0)	E (72.0)	E (73.0)	E (72.0)	E (73.0)	E (72.0)
		NB	E (65.7)	C (26.5)	F (195.7)	F (299.8)	F (234.8)	F (364.8)
		SB	<u>B (16.7)</u>	<u>B (14.7)</u>	<u>F (236.1)</u>	<u>C (30.4)</u>	<u>F (269.6)</u>	<u>D (48.2)</u>
		Overall	<u>D (41.3)</u>	<u>C (22.7)</u>	<u>F (211.7)</u>	<u>F (191.6)</u>	<u>F (245.8)</u>	<u>F (239.8)</u>
	Signal Timing Modification	EB	N/A	N/A	N/A	N/A	E (73.0)	E (72.0)
		NB	N/A	N/A	N/A	N/A	F (136.2)	F (300.6)
		SB	N/A	N/A	N/A	N/A	<u>F (271.7)</u>	<u>D (52.2)</u>
		Overall	N/A	N/A	N/A	N/A	<u>F (209.0)</u>	<u>F (202.6)</u>
2 Centreville Road/ Right In - Right Out Site Access	Stop Sign	EBR	N/A	N/A	N/A	N/A	F [67.8]	D [27.0]
3 Centreville Road/ Woodland Park Drive/ Site Access	Signal	EB	N/A	N/A	N/A	N/A	N/A	N/A
		WB	D (41.0)	D (50.5)	D (40.8)	E (72.1)	N/A	N/A
		NB	C (30.8)	C (28.1)	F (199.3)	F (475.1)	N/A	N/A
		SB	<u>D (48.5)</u>	<u>B (13.7)</u>	<u>F (193.1)</u>	<u>B (15.2)</u>	N/A	N/A
		Overall	<u>D (40.5)</u>	<u>C (22.8)</u>	<u>F (194.0)</u>	<u>F (276.1)</u>	N/A	N/A
	Signal Phasing/Timing Modification (attributed to addition of new movements)	EB	N/A	N/A	N/A	N/A	F (122.9)	F (663.7)
		WB	N/A	N/A	N/A	N/A	E (67.5)	F (761.7)
		NB	N/A	N/A	N/A	N/A	F (217.5)	F (608.8)
		SB	N/A	N/A	N/A	N/A	<u>F (303.0)</u>	<u>D (40.1)</u>
		Overall	N/A	N/A	N/A	N/A	<u>F (263.7)</u>	<u>F (417.1)</u>
Lane reconfiguration	Signal	EB	N/A	N/A	N/A	N/A	E (71.5)	F (202.9)
		WB	N/A	N/A	N/A	N/A	E (74.9)	F (151.9)
		NB	N/A	N/A	N/A	N/A	F (150.5)	F (384.8)
		SB	N/A	N/A	N/A	N/A	<u>F (253.5)</u>	<u>F (93.4)</u>
		Overall	N/A	N/A	N/A	N/A	<u>F (208.8)</u>	<u>F (257.4)</u>
4 Centreville Road/ Sunrise Valley Drive	Signal	EB	E (58.0)	E (62.0)	F (192.3)	F (467.6)	F (262.5)	F (472.6)
		WB	E (60.1)	F (87.0)	F (390.8)	F (449.3)	F (442.6)	F (450.3)
		NB	D (36.8)	E (67.3)	E (70.0)	F (398.5)	E (74.5)	F (379.3)
		SB	<u>C (34.9)</u>	<u>E (64.7)</u>	<u>D (50.2)</u>	<u>D (48.1)</u>	<u>D (52.5)</u>	<u>D (49.7)</u>
		Overall	<u>D (39.6)</u>	<u>E (68.4)</u>	<u>F (138.0)</u>	<u>F (334.2)</u>	<u>F (163.1)</u>	<u>F (333.1)</u>
	Signal Timing Modification	EB	N/A	N/A	N/A	N/A	F (154.3)	F (350.9)
		WB	N/A	N/A	N/A	N/A	F (147.7)	F (345.0)
		NB	N/A	N/A	N/A	N/A	F (109.5)	F (254.4)
		SB	N/A	N/A	N/A	N/A	F (101.5)	F (116.8)
		Overall	N/A	N/A	N/A	N/A	<u>F (120.7)</u>	<u>F (261.5)</u>
5 Sunrise Valley Drive/ Site Access	Stop Sign	EBLT	N/A	N/A	N/A	N/A	D [31.0]	B [10.8]
		SBL	N/A	N/A	N/A	N/A	F *	F *
		SBR	N/A	N/A	N/A	N/A	C [20.8]	B [13.0]
		SB (Overall)	N/A	N/A	N/A	N/A	F *	<u>F [844.2]</u>
	Signal Addition and Lane Use Change	EB	N/A	N/A	N/A	N/A	A (6.0)	B (11.3)
		WB	N/A	N/A	N/A	N/A	B (11.5)	B (11.2)
		SB	N/A	N/A	N/A	N/A	E (56.7)	E (65.9)
		Overall	N/A	N/A	N/A	N/A	<u>B (12.2)</u>	<u>B (16.2)</u>
6 Sunrise Valley Drive/ Dulles Technology Drive	Stop Sign	EBL	A [9.7]	A [8.0]	C [24.3]	B [11.0]	C [25.0]	B [11.8]
		WBL	A [8.5]	A [9.4]	C [18.9]	D [26.7]	C [23.6]	D [28.6]
		NBL	D [31.7]	C [24.1]	F *	F *	F *	F *
		NBTR	A [9.4]	B [12.4]	B [13.5]	F [332.6]	F *	F [433.8]
		NB (Overall)	<u>B [10.5]</u>	<u>B [12.9]</u>	F *	<u>F [694.3]</u>	F *	<u>F [928.0]</u>
		SBLTR	E [47.3]	C [19.8]	F *	F *	F *	F *
		SB (Overall)	<u>E [47.3]</u>	<u>C [19.8]</u>	F *	F *	F *	F *

Notes:

(1) Numbers in parentheses, (), represent approach delay, in seconds per vehicle for signalized intersections.

(2) Numbers in brackets, [], represent approach delay, in seconds per vehicle for unsignalized intersections.

Directional Distributions

The directional distribution of background and site-generated trips was determined based on a review of other area studies, existing traffic patterns, and local knowledge. The directional distributions contained herein were reviewed and approved by both Fairfax County and Virginia Department of Transportation staff (see Appendix D - Scoping Agreement). Different distributions were developed for commercial and residential land uses as follows:

-	Office, hotel, and retail	
•	From the north on Centreville Road	45%
▪	35% from Dulles Toll Road	
▪	10% from Centreville Road	
•	From the south on Centreville Road	20%
•	From the west on Sunrise Valley Drive	20%
•	From the east on Sunrise Valley Drive	15%
	Total	100%
-	Residential	
•	From the north on Centreville Road	45%
▪	35% from Dulles Toll Road	
▪	10% from Centreville Road	
•	From the south on Centreville Road	35%
•	From the west on Sunrise Valley Drive	5%
•	From the east on Sunrise Valley Drive	15%
	Total	100%

Background Traffic Forecasts

Overview. The development of background traffic forecasts for the build out year of 2010 were based on a composite of baseline traffic, annual growth factors, and traffic generated by ten other approved but as yet incomplete developments.

Annual Growth. Annual regional traffic growth was estimated for the surrounding road network based on a review of historic traffic counts, and information obtained from the Traffic

Analysis and Station Access Study - Technical Report, prepared for the Dulles Corridor Rapid Transit Project for the "no-build" alternative. The resulting growth rates for each major link in the site's vicinity are presented in Appendix H, Figure H-1. These rates were then applied to the through volumes on each link and compounded annually over the eight-year study period in order to account for regional traffic growth.

Other Development Traffic. In addition to the increases in traffic due to regional growth, trips associated with ten other approved/pending development projects, as coordinated with County staff, were included in the 2010 background traffic forecasts. These projects included the following:

- Dulles Technology Park (Vacant Portion)
- Dulles Corner
- Pomeroy
- Woodland Park
- Waterview
- Dulles Station
- Lincoln at Coppermine
- West Rocks
- Presidential Park (Vacant Portion)
- McNair Farms

The location of each project is shown on Figure 9.

The level of development in 2010 at each of the other area projects listed above was estimated based on the ultimate approved development program, the projected pace of development in the study area, previous traffic studies, local knowledge and information obtained from Metropolitan Washington Council of Governments. Commercial and residential absorption rates in the Dulles Corridor were obtained from the files and library of the Metropolitan Washington Council of Governments (COG). The methodology and application employed is explained in detail in a memorandum to Fairfax County Department of Transportation Staff dated April 14, 2003 and is included as Appendix I to this report.

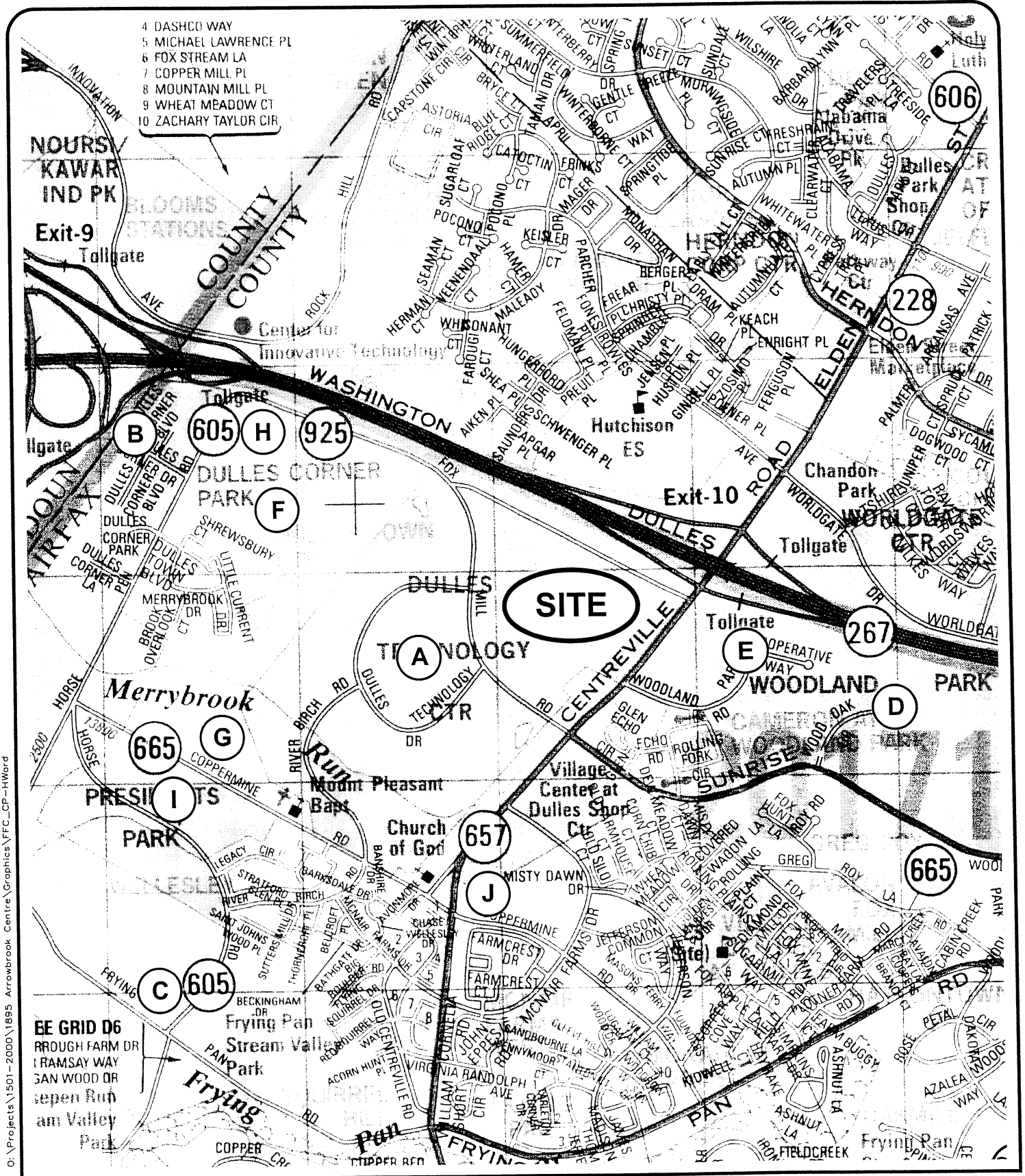


Figure 9
Background Development
Site Locations

Development Programs. The approved development program and number of residential dwelling units and square footage of commercial space anticipated to be developed for each of the ten projects listed above at build out and in 2010 are summarized on Table 2.

These project-by-project development forecasts were prepared for the sole purpose of reasonably estimating background traffic volumes in the study area. Individual projects may develop at a faster or slower pace than forecasted here. The background traffic forecasts contained in this report will still pertain, to the extent that overall development levels and general distribution assumptions remain valid.

Other Development Trip Generation. The volume of trips anticipated to be generated by each of the other approved/pending projects was calculated based on standard Institute of Traffic Engineers (ITE) 6th edition Trip Generation and/or Fairfax County Department of Transportation rates/equations as applicable. The resulting trip generation is presented on Table 3.

Other Development Trip Assignments. The traffic generated by the ten other approved/pending projects was assigned to the surrounding road network based on the directional distributions agreed to with County and VDOT staff. Individual project assignments are summarized in Appendix I, Figures I-1 through I-10. The resulting total traffic forecasts are depicted on Figure 10.

Total Background Traffic Forecasts. The total future background traffic forecasts shown on Figure 11 are a composite of the balanced volumes depicted in Figure 8, the regional growth factors summarized on Figure H-1, and the other development trip assignments depicted Figure 10.

Table 2
Arrowbrook Centre
Background Development Programs

Land Use	Approved/Planned		Assumed Built by 2010	
	Size	Units	Size	Units
Development				
<u>Dulles Technology Park</u>				
Office	366,000	SF	366,000	SF
<u>Dulles Corner</u>				
Office	717,000	SF	270,000	SF
Office Park	570,000	SF	210,000	SF
Hotel	300	Rooms	300	Rooms
<u>Pomeroy</u>				
Office	3,842,000	SF	1,380,000	SF
<u>Woodland Park</u>				
Office	1,500,000	SF	540,000	SF
Apartment	584	DU's	584	DU's
<u>Waterview</u>				
Office	455,555	SF	170,000	SF
<u>Dulles Station</u>				
Office	1,505,000	SF	550,000	SF
Apartment	1,095	DU's	1,095	DU's
<u>Lincoln Coppermine</u>				
Townhouse	282	DU's	282	DU's
Apartment	348	DU's	348	DU's
Elementary School	900	Students	900	Students
<u>West Rocks</u>				
Office	324,000	SF	120,000	SF
<u>Presidential Park</u>				
Office	402,000	SF	402,000	SF
<u>McNair Farms</u>				
Hotel	142	Rooms	142	Rooms
Retail	30,000	SF	20,000	SF
<u>Totals</u>				
Residential	2,309	DU's	2,309	DU's
Nonresidential	9,711,555	SF	4,028,000	SF
School	900	Students	900	Students
Hotel	442	Rooms	442	Rooms

Table 3
Arrowbrook Centre
Background Trip Generation (1)

Background Trip Generation (1)										
Land Use	ITE Code	Size	Units	AM Peak Hour			PM Peak Hour			ADT
				IN	OUT	TOTAL	IN	OUT	TOTAL	
Development										
<u>Dulles Technology Park</u>										
Office	710	366,000	SF	461	63	524	83	407	490	3,595
<u>Dulles Corner</u>										
Office	710	270,000	SF	415	56	471	78	383	461	3,322
Office Park	750	210,000	SF	363	45	408	51	310	361	2,598
Hotel	310	300	Rooms	98	62	160	91	81	172	2,316
<u>Pomeroy</u>										
Office	710	1,380,000	SF	1,501	204	1,705	290	1,416	1,706	11,447
<u>Woodland Park</u>										
Office	710	540,000	SF	718	98	816	130	634	764	5,633
Apartment	220	584	DU's	47	246	293	224	111	335	3,635
<u>Waterview</u>										
Office	710	170,000	SF	251	34	285	46	224	270	1,995
<u>Dulles Station</u>										
Office	710	550,000	SF	759	104	863	146	708	854	6,007
Apartment	220	1,095	DU's	88	459	547	409	202	611	6,698
<u>Lincoln Coppermine</u>										
Townhouse	230	282	DU's	20	96	116	97	48	145	1,571
Apartment	220	348	DU's	28	148	176	139	68	207	2,220
Elementary School	520	900	Students	154	107	261	-	-	-	866
<u>West Rocks</u>										
Office	710	120,000	SF	190	26	216	36	178	214	1,527
<u>Presidential Park</u>										
Office	710	402,000	SF	572	78	650	104	506	610	4,538
<u>McNair Farms</u>										
Hotel	310	142	Rooms	38	25	63	37	33	70	902
Retail	814	20,000	SF	29	18	47	22	30	52	813
Total				5,732	1,869	7,601	1,983	5,339	7,322	59,683

Notes:

(1) Trips generated using Institute of Transportation Engineers (ITE) Trip Generation Sixth Edition.

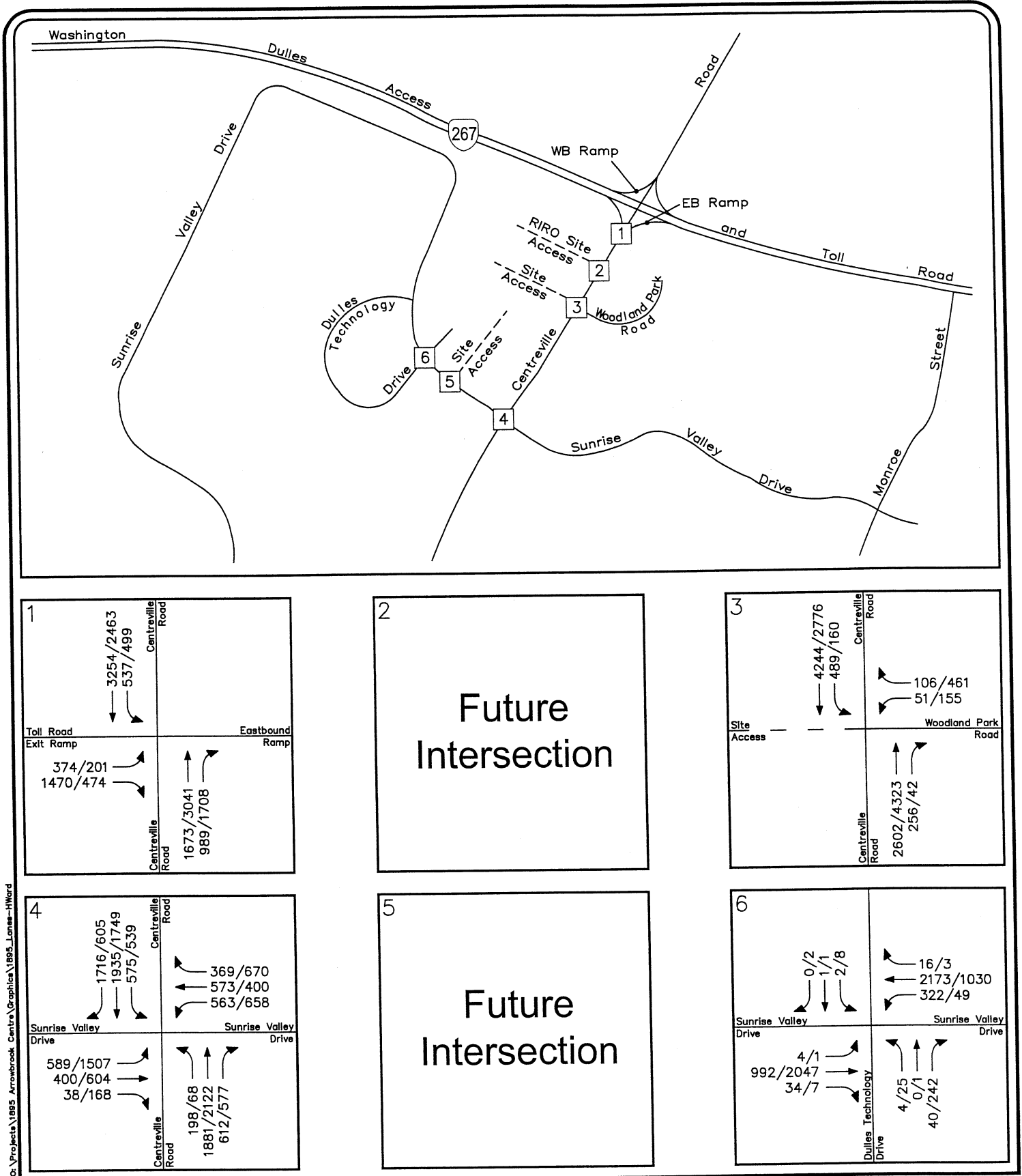


Figure 11
Total Future Background Traffic Forecasts

AM PEAK HOUR
PM PEAK HOUR
000/000

North
Schematic

Future Background Levels of Service

Background levels of service (LOS) at the key study intersections were calculated based on: (1) the total future background forecasts reflected on Figure 11; (2) the future lane use and traffic controls depicted on Figure 6; (3) VDOT signal timings/phasing (See Appendix E); and (4) the Highway Capacity Manual 2000 (HCM) methodologies for unsignalized and signalized intersections (HCS software version 4.1c). The results of these analyses are presented in Appendix J and summarized in Table 1.

As shown in Table 1, the signalized intersections on Centreville Road at Sunrise Valley Drive, Woodland Park Road and the eastbound Toll Road ramps will operate at capacity during both AM and PM peak hours in the year 2010. Volume to capacity ratios averaging 1.77 indicate saturated or congested conditions.

Critical movements at the unsignalized intersection of Sunrise Valley Drive and Dulles Technology Drive will operate at LOS "C" eastbound and westbound during the AM peak hour, and LOS "B" eastbound and "D" westbound during the PM peak hour. The north and southbound side street approaches will operate at capacity during one or more peak periods.

Site Trip Generation

The volume of trips anticipated to be generated by the development of Arrowbrook Centre was estimated based on standard Institute of Transportation Engineers (ITE) 6th Edition Trip Generation and/or Fairfax County Department of Transportation rates/equations as applicable.

The conceptual plan prepared by Davis Carter Scott provides for the following levels of development:

- 550,000 Gross Square Feet (GSF) of office uses
- 1,056 multi-family residential units
- 300 hotel rooms
- 176,372 GSF of retail uses

As shown in Table 4, this level of development would generate a total of 1,381 AM peak hour trips (861 inbound; 520 outbound), 1,817 PM peak hour trips (733 inbound; 1,084 outbound), and 20,018 average daily trips exclusive of any trip reductions due to synergy and/or demand management programs. With the trip adjustments described below, the site would generate a total of net new 1,020 AM peak hour trips, 1,248 PM peak hour trips and 19,281 daily trips.

Applied Trip Reductions

Synergy. The development plan proposed for Arrowbrook Centre reflects a mix of office, hotel, retail, and residential development. By its very nature as a mixed-use development, the land uses within the development would experience a naturally occurring synergy. It is anticipated that a portion of individual trips could be reduced among the land uses to account for office patrons that live within the development, and retail customers that live and/or work on-site as well. As a result of this naturally occurring synergy, the volume of trips anticipated to be generated by the site would be reduced.

Several case studies of internal trip capture are contained in the ITE publication Trip Generation, 5th edition. The Virginia Transportation Research Council reports capture rates of 27 percent of all PM peak hour trips and 17 percent of all daily trips at a multi-use site in northern Virginia. The Brandermill PUD near Richmond, Virginia had capture rates of 45% in the AM peak hour, 55% in the PM peak hour, and 51% over a 24-hour period. Similarly, the Colorado-Wyoming Section of ITE reported capture rates of up to 37% in the AM peak hour, 45% in the PM peak hour, and 20% over the 24-hour period.

In the interests of conservatism, only a 15% reduction as permitted by VDOT, was generally applied in order to account for this synergistic effect among the mix of land uses. Trips between the residential and hotel uses were reduced by only 5%. With the application of the above synergy reductions, fewer vehicles will enter the surrounding off-site road network.

Table 4
Arrowbrook Centre
Trip Generation Analysis

Land Use	ITE Land Use Code	Average Vehicle Occupancy	Amount	Units	AM Peak Hour		PM Peak Hour		Total	ADT
					In	Out	In	Out		
Office	710	1.2	550,000 SF	639	87	726	118	578	696	4,915
				543	74	617	100	491	592	4,178
				652	89	741	120	590	710	5,014
				68	34	102	51	101	152	
				584	55	639	69	489	558	
Total External Vehicle Trips			487	46	533	58	408	466		
Residential	230/232	1.0	1,056 DU's	70	337	407	327	165	492	5,461
				70	337	407	327	165	492	5,461
				21	67	88	102	48	150	
				49	270	319	225	117	342	
				Total External Vehicle Trips			49	270	319	225
Hotel	310	1.2	300 Rooms	98	62	160	91	81	172	2,469
				118	74	192	109	97	206	2,963
				25	25	50	37	35	72	
				93	49	142	72	62	134	
				Total External Vehicle Trips			78	41	119	60
Retail	814 (4)	1.23	176,372 SF	54	34	88	197	260	457	7,173
				66	42	108	242	320	562	8,823
				30	18	48	76	82	158	
				36	24	60	166	238	404	
				Total External Vehicle Trips			29	20	49	135
TOTAL VEHICLE TRIPS										
TOTAL VEHICLE TRIPS (with TDM)										
TOTAL PERSON TRIPS										
TOTAL INTERNAL PERSON TRIPS										
TOTAL EXTERNAL PERSON TRIPS										
TOTAL EXTERNAL VEHICLE TRIPS										
PERCENT REDUCTION (VEHICLE TRIPS)										
					19.8%		27.1%			

Notes:
 (1) Average Vehicle Occupancy determined from Institute of Transportation Engineers Trip Generation 5th Edition.
 (2) Average Vehicle Occupancy assumed at 1.0 persons/vehicle
 (3) Average Vehicle Occupancy assumed at 1.2 persons/vehicle
 (4) AM Trips generated using Fairfax County rate with AM distribution for Shopping Center from ITE.

Transportation Demand Management (TDM). In addition, to over 1,000 residential units, Arrowbrook Centre provides for over a half million square feet of premium office space. Given the type of high technology companies that are located along the Dulles corridor, it is likely that similar firms would be located within the project. Generally, these firms attract many employees that work long, irregular hours. Such companies are ideally suited to travel demand management (TDM) programs. Peak hour arrivals and departures there, could be more dispersed than typical office and R&D uses. Employers could also encourage employees to carpool and vanpool or take transit services to work.

The implementation of transportation demand management programs are also recognized by the Comprehensive Plan for the Dulles Suburban Center as a key component to meeting the transportation demands within the area. The Policy Plan sets a goal of a 15% reduction in single occupant vehicle trips for suburban activity centers. Accordingly, in addition to reductions associated with synergy, a fifteen (15) percent reduction in peak hour trips was applied to the office component of the project due to anticipated TDM actions. No TDM reduction was assumed for the retail or hotel components of the project.

Site-Generated Traffic Assignments

The net new site-generated traffic volumes shown in Table 4 were assigned to the surrounding road network based on the previously noted directional distributions and entrance assignments discussed below. The resulting site traffic assignments are presented on Figure 12.

The current plan reflects access to the site via two full movement entrances one each on Centreville Road and Sunrise Valley Drive. An additional right-in/right-out is proposed to be

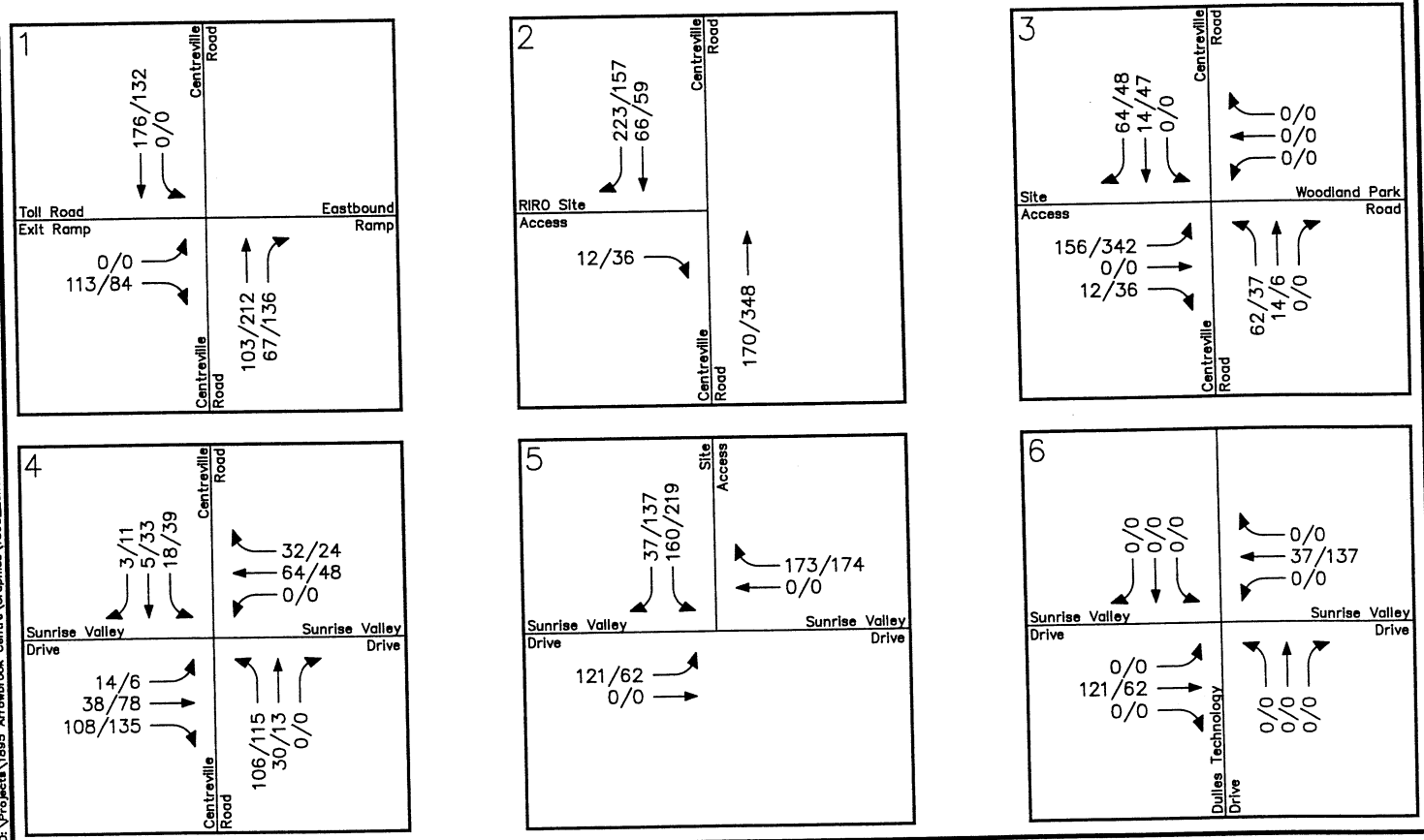
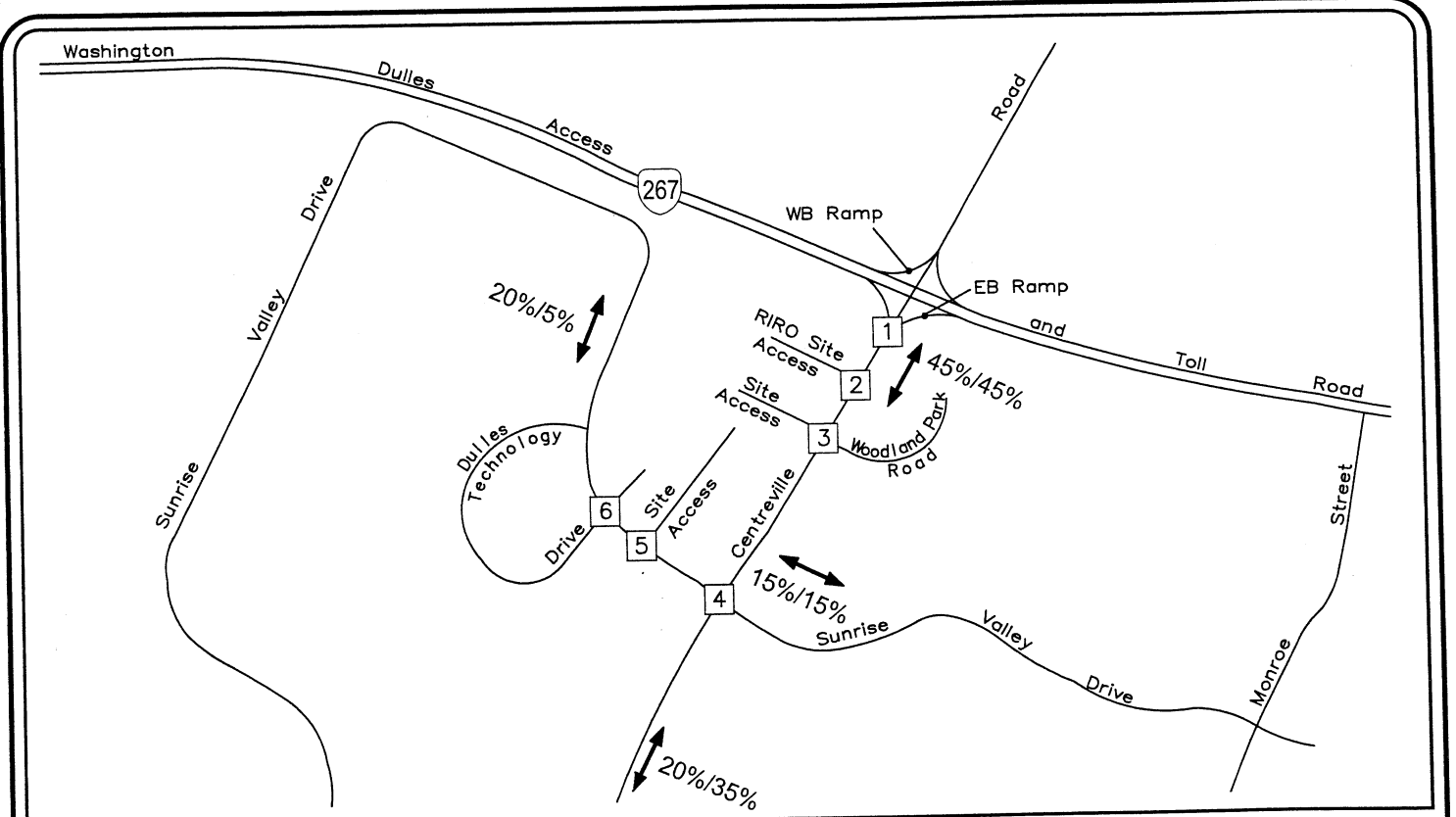


Figure 12
Site-Generated Trips and Directional Distributions

AM PEAK HOUR
PM PEAK HOUR
Office/Hotel/Retail
Residential
North
Schematic

provided on Centreville Road just south of the eastbound Toll Road ramps. The distribution of site-generated traffic among the site entrances/exits was determined as follows:

- **Office, hotel, and retail**
 - 55% on Centreville Road
 - 45% on Sunrise Valley Drive
- **Residential**
 - 45% on Centreville Road
 - 55% on Sunrise Valley Drive

Total Future Traffic Forecasts

Total future traffic forecasts for the year 2010 were developed based on a composite of the total future background traffic forecasts depicted on Figure 11 and the site-generated traffic forecasts shown on Figure 12. The resulting total future forecasts are depicted on Figure 13.

Total Future Levels of Service

Overview. Total future levels of service (LOS) at the study intersections were calculated based on: (1) the total future traffic forecasts reflected on Figure 13; (2) the future lane use and traffic controls depicted on Figure 6; (3) VDOT signal timings/phasing (See Appendix E); and (4) the Highway Capacity Manual 2000 (HCM) methodologies for unsignalized and signalized intersections (HCS software version 4.1c). The results of these analyses are presented in Appendix K and summarized in Table 1.

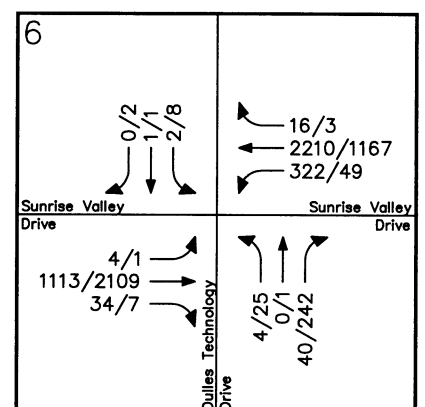
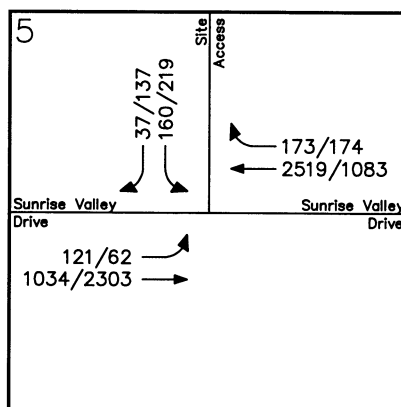
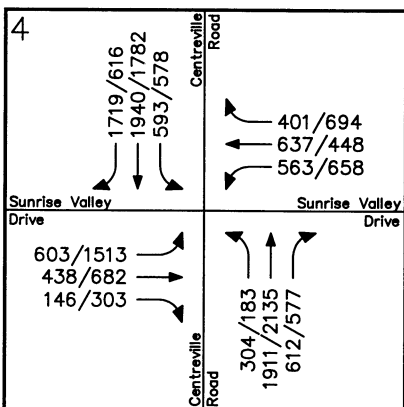
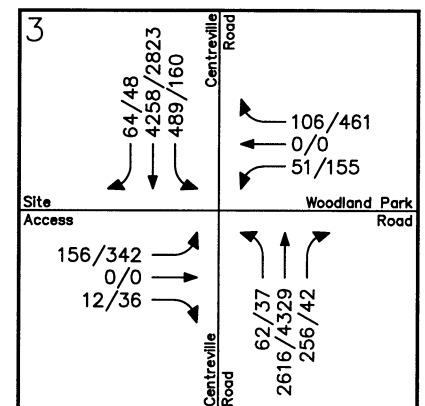
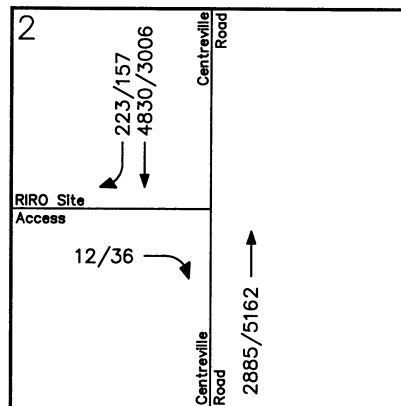
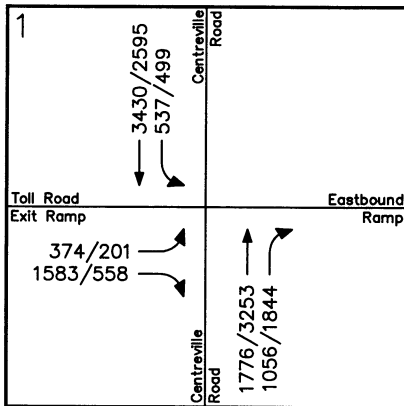
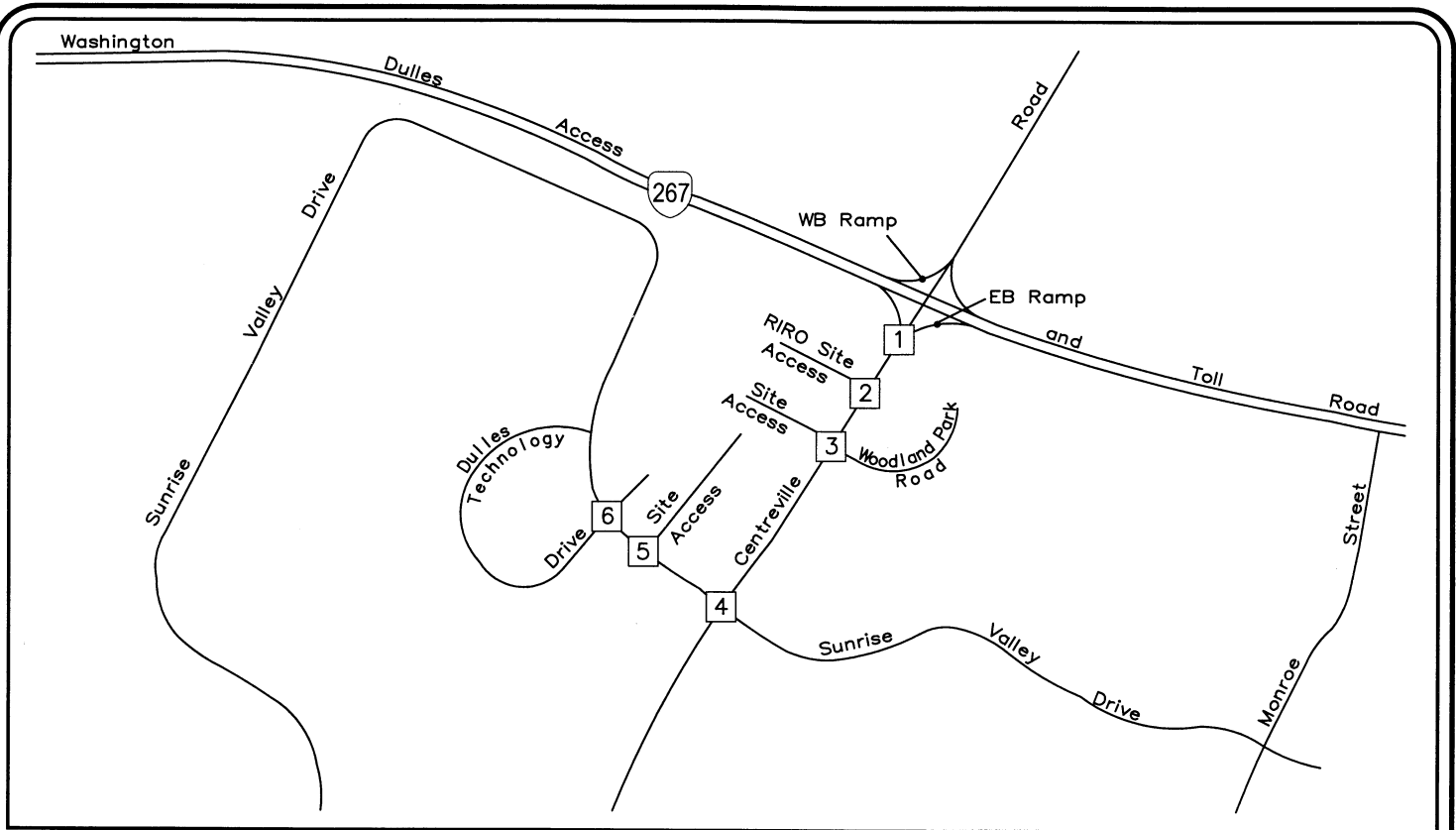


Figure 13
Total Future Traffic Forecasts

AM PEAK HOUR
PM PEAK HOUR
000/000

North
Schematic

Results. The critical movements at the unsignalized intersection of Sunrise Valley Drive and Dulles Technology Drive will operate at LOS "C" eastbound and westbound during the AM peak hour, and LOS "B" eastbound and "D" westbound during the PM peak hour. This will be fairly consistent with Background levels of service. The north and southbound movements will continue to operate at capacity, during both AM and PM peak hours, with extraordinarily long delays.

Two new entrances are proposed to be constructed in order to facilitate access to/from the property; a right-in/right-out on Centreville Road and a new full movement entrance on Sunrise Valley Drive. The critical movement of the right-in/right-out intersection on Centreville Road (eastbound right) will operate at capacity, with a delay of 67.8 seconds during the AM peak hour, and at LOS "D" with a delay of 27.0 seconds during the PM peak hour. The critical southbound movement at the site entrance on Sunrise Valley Drive would operate at capacity under STOP control during both AM and PM peak hours. The critical eastbound left movement will operate at LOS "D" with a delay of 31.0 seconds during the AM peak hour and LOS "B" with a 10.8 second delay during the PM peak hour. The addition of a signal at this location will significantly improve the overall intersection level of service. Using a 140-second cycle length consistent with the Centreville Road signal system, the intersection will operate with an overall LOS "B" during the AM and PM peak hours.

As shown in Table 1, the signalized intersections on Centreville Road at Sunrise Valley Drive, Woodland Park Road and the eastbound Toll Road ramps will continue to operate at capacity during both AM and PM peak hours. Overall north and southbound delays average 184.2 seconds per vehicle. With modifications to existing signal timings/phasing, delays can be decreased by as much as 17 seconds in the AM peak hour and 72 seconds in the PM peak hour when compared to background forecasts. However, the subject intersections will continue to operate at capacity with average volume to capacity ratios of 1.22 indicating continued congestion.

Peak Spreading. As congestion increases, a shift in driver patterns occurs whereby the pattern of traffic demand changes from one peak hour (or "rush hour") to one where the demand is spread out over a longer period. Typically, this demand shifts to the "shoulder" hours or the hour before and/or after "rush" hour. Because of the constraints associated with road capacity, peak spreading is one way of accommodating increasing traffic volumes.

Peak Traffic Spreading in Urban Environments

Overview. Estimating the peak hour demand associated with a proposed land use is of crucial importance when evaluating road capacity and the associated costs and improvements necessary to provide and maintain this capacity. Traditionally this peak hour of demand has been anticipated to occur during the commuting "rush" hour, and improvements required/requested of landowners are based on capacity improvements necessary to accommodate this "peak" traffic. As a result, much of a road's capacity is under-utilized for the majority of a day. By forcing a portion of the traffic into the "shoulder" hours, a more optimal use of existing and future capacity is realized.

The phenomenon of peak spreading is one way of accommodating increased traffic volumes. A review of the literature on peak spreading reveals various reasons why the peak period will lengthen over time. As area drivers are confronted with increasing levels of congestion, the individual trip maker will make a conscious decision to travel earlier or later and avoid the peak hour operating at or near capacity. In this case, the driver trades congestion and their preferred travel time in favor of reduced commute times.

As drivers adjust their commute times, the peak period is flattened and extended. By utilizing the "shoulder hours," the surrounding network is optimized and increased traffic volumes can be accommodated. Traditional trip assignments result in a greater difference between average and peak flows; concentrating the peak hour into a short time period and breaching capacity.

Incidences of this phenomenon are well documented and considered a "reality" of 21st century commuting. It is not unreasonable to assume that given the nature of land uses and traffic patterns in the Dulles Corridor that shifts in commuting patterns will occur. Policy makers throughout the region are investigating how best to incorporate peak spreading into the modeling framework. For example, the Dulles Corridor Transportation Study completed by Parsons Brinkerhoff (ACT, 1997) recognized this concept.

Analysis of Shoulder Hours. In order to determine if excess capacity exists at key study intersections in the Centreville Road corridor, existing levels of service were computed for one or more "shoulder hours." The results are reflected on Table 5. As shown on Table 5, the key Centreville Road intersections operate at much improved levels of service during the periods before and/or after "rush hour" and excess capacity is available to handle the traffic associated with the Plan recommended build out of Land Unit A, including Arrowbrook Centre.

Table 5
Arrowbrook Centre
Level of Service Summary (1) (2)

Intersection	Traffic Control	Critical Movement	AM Before	Existing	PM After
				Before	
1 Centreville Road/ Eastbound Dulles Toll Access Road Ramp	Signal		7:00-8:00	4:00-5:00	6:00-7:00
		EB	D (45.0)	E (58.6)	E (56.6)
		NB	E (79.7)	B (17.0)	B (17.2)
		SB	<u>B (19.8)</u>	<u>B (13.1)</u>	<u>B (13.3)</u>
		Overall	D (46.2)	B (16.9)	B (16.6)
3 Centreville Road/ Woodland Park Drive/ Site Access	Signal		7:00-8:00	4:15-5:15	6:00-7:00
		EB	N/A	N/A	N/A
		WB	D (40.8)	D (45.0)	D (42.4)
		NB	C (27.1)	C (23.4)	C (23.2)
		SB	<u>B (14.6)</u>	<u>A (9.2)</u>	<u>B (10.6)</u>
		Overall	C (21.2)	B (18.1)	B (17.5)
4 Centreville Road/ Sunrise Valley Drive	Signal		7:00-8:00	4:00-5:00	6:00-7:00
		EB	E (55.2)	D (48.8)	D (50.4)
		WB	E (58.8)	E (60.9)	E (66.4)
		NB	C (33.1)	D (52.1)	D (51.8)
		SB	<u>C (26.9)</u>	<u>D (39.0)</u>	<u>D (50.3)</u>
		Overall	C (34.3)	D (47.4)	D (53.2)

Notes:

- (1) Numbers in parentheses, (), represent approach delay, in seconds per vehicle for signalized intersections.
(2) Numbers in brackets, [], represent approach delay, in seconds per vehicle for unsignalized intersections.

CONCLUSIONS AND FINDINGS

The conclusions of this traffic impact assessment are as follows:

1. Concentrating densities, pedestrian-friendly, mixed-use development in designated suburban activity centers and proximate to future rail stations, such as Arrowbrook Centre, is the best plan for responsible and smart growth in Fairfax County.
2. According to the Comprehensive Plan, the estimated maximum amount of non-residential development that could occur in the Dulles Suburban Center, given "stable" development, proffered intensities, and by-right zoning is over 140 million gross square feet of floor area.
3. Development within Land Unit A is projected to increase dramatically within the next 10 years. A total of 4.0 million square feet of non-residential development and over 2,300 residential units are either planned, and/or approved and anticipated to be built by the year 2010 based on COG absorption rates.
4. This level of development within the Land Unit could generate an additional 7,601 AM peak hour trips, 7,322 PM peak hour trips and 59,683 daily trips upon completion based on typical, auto-oriented, suburban development practices.
5. Road improvements proffered by neighboring developments within Land Unit A may increase capacity in the short and long-term at select locations. This additional capacity probably will not completely offset future increases in area-wide traffic volumes. Analyses have shown that in the year 2010, without the development of Arrowbrook Centre, key study intersections would operate at capacity.
6. The development of Arrowbrook Centre, as proposed, would add 1,020 new AM peak hour trips, 1,248 new PM peak hour trips, and 19,281 daily trips to the

surrounding street system upon completion. The level of development proposed is compatible with the Plan recommendations for the property.

7. The development of Arrowbrook Centre, based on the parameters assumed herein, will have an impact on the surrounding street system. Although intersection levels of service generally remain consistent with background levels increased vehicle delays would occur.

The implementation of mass transit in the Dulles corridor, combined with enhanced and aggressive TDM measures, would result in further mitigation of impacts. Locating residential and commercial uses, such as those proposed by the applicant within a half mile of the future Route 28/CIT transit station will increase mode splits and reduce the volume of single occupant vehicle trips beyond those referenced herein.

8. As congestion occurs and increases, a shift in driver patterns would occur whereby traffic demand is spread out over longer periods. By forcing a portion of the demand into the "shoulder hours", a more optimal use of existing and future capacity is realized.
9. In order to mitigate the impacts associated with the Arrowbrook Centre development, the following improvements are recommended:
 - a. Provision of dual left-turn lanes on northbound Centreville Road at the site entrance opposite Woodland Park Road
 - b. Provision of an exclusive right-turn deceleration lane on southbound Centreville Road at the site's entrances
 - c. Signal modifications to the Centreville Road/Woodland Park Road intersection

- d. Provision of exclusive right and left-turn deceleration lanes into the site entrance on Sunrise Valley Drive
- e. Provision of a traffic signal when warranted at the site's proposed entrance on Sunrise Valley Drive
- f. Provision of an integrated pedestrian network to connect with the future BRT and/or rail station platform.
- g. Commitments to provide a transportation systems management program, the goal of which is to achieve a minimum 15% mode split